

metals review

the news digest magazine

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Volume XXVIII-No. 5

May, 1955

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Powder Metallurgy in Atomic Energy



CONVENTION—PHILADELPHIA, OCTOBER 17-21, 1955

Jointly sponsored by U.S. Atomic
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General Chairman:
HENRY H. HAUSNER,
Manager of Atomic Energy Engineering
Sylvania Electric Products, Inc.

**1. "General Metallurgical Problems in the Design
of Nuclear Power Reactors"**

Vincent P. Calkins
*Aircraft Nuclear Propulsion Project
General Electric Co.*

**2. "Preparation of Metal Powders for Nuclear
Reactor Purposes"**

Premo Chiotti and Harley A. Wilhelm
*Institute for Atomic Research
Iowa State College*

**3. "The Latest Developments in the Theory of
Sintering"**

Leslie L. Seigle, Head
*Fundamental Metallurgy Section
Sylvania Electric Products, Inc.*

**4. "The Powder Metallurgy of Beryllium and
Zirconium"**

Harold Hirsch
*Knolls Atomic Power Laboratory
General Electric Co.*

5. "Alloy Formation by Powder Metallurgy"

Henry A. Saller and Frank A. Rough
Battelle Memorial Institute

**6. "New Methods of Powder Metallurgy for
Nuclear Reactor Purposes"**

William D. Manly
Oak Ridge National Laboratory

**7. "Safe Handling of Pyrophoric and Radioactive
Materials"**

L. R. Kelman, A.B. Shuck and R. C. Goertz
Argonne National Laboratory

this meeting one of the
many big features at the . . .

NATIONAL METAL CONGRESS & EXPOSITION—PHILADELPHIA

Metals Review

VOLUME XXVIII, 5

May, 1955

THE NEWS DIGEST MAGAZINE



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(3) MAY, 1955

Western Ontario Hears Talk on Bronze



O. B. Frohman, Consulting Engineer, Ampco Metals Inc., Gave a Talk on "Application of Bronzes for Forming and Drawing of Metals" During a Recent Meeting Held by the Western Ontario Chapter. Shown are, from left: D. J. Kennedy, Lyman Tube and Bearings Ltd.; H. G. Shepherd, technical chairman of the meeting; Mr. Frohman; and L. McCall, Canadian Liquid Air Co. The talk touched on practically all phases of the manufacturing and end uses of all types of aluminum bronzes. (Reported by H. G. Shepherd)

North Texas Talk on Hot Work of Metals

Speaker: Alexander Zeitlin
Loewy Construction Co.

Alexander Zeitlin, vice-president, Loewy Construction Co., presented a talk on "Hot Working of Metals—Heavy Press Extrusion and Forging" at a meeting held by North Texas.

Mr. Zeitlin stated that hydraulic presses of very large capacities are being used today for extruding intricate shapes made of brass and ferrous and light metals, as well as for the hot and cold forming of steel and aluminum and discussed presses used in the aircraft industry.

Slides illustrating closed-die forging operations were shown and discussed, as well as the press forming of aircraft frames and comparisons of hydraulic presses as to components above and below the floor. Problems involved in transportation and assembly of these presses were pointed out and a 35,000-ton press, an 8000-ton extrusion press and 108-in. diam. forging ingot illustrated.

Mr. Zeitlin discussed stress concentration in new forging hammers and showed how stresses are distributed in the cylinder wall and flange of a large hydraulic press. He also mentioned that five years ago, closed-die forgings with a 5° draft angle were acceptable, but forgings with a 1 to 1½° draft angle are being made today.

One slide illustrated the different sizes of billets that can be extruded in presses of various capacities; an-

other showed the different types of extrusions that were produced of soft aluminum alloys in 1945 and 1946, and others illustrated a photo-elastic study of stress in billet containers and the development of metal flow in extrusion dies.

The trend is to use low-carbon steel for forgings and the main problem is heating large billets up to 2200° F. uniformly. A program for the extrusion of gun tubes has been

successfully completed. The 20-mm. and 75-mm. gun tubes are extruded in one operation each but, because the 57-mm. gun tubes have three different diameters, they are extruded in two operations.

Titanium is an excellent material for extrusions but has a bad habit of alloying with many materials, including those contained in lubricants, which form a tough sticky surface. Mr. Zeitlin hopes that information on extruding titanium with a good surface will be available within the next few months.

The designer of heavy forging presses today must consider the entire production line showing all auxiliary equipment and all steps in the fabrication and handling as well as the product.—Reported by R. E. Hopper for North Texas Chapter.

St. Louis Joint Meeting Hears Electroplating Talk

Speaker: Henry Brown
Udylite Research Corp.

Henry Brown, Udylite Research Corp., spoke on "Corrosion Protection With Various Electroplated Metals" at a joint meeting of the St. Louis Chapters of the American Society for Metals and the American Electroplaters Society.

Dr. Brown's talk dealt with the corrosion protection of various electroplated metals, principally copper, nickel, nickel-cobalt, nickel-iron, chromium, silver, gold and rhodium. He also discussed the sacrificially protecting metals, cadmium and zinc.—Reported by W. M. Holtgrieve for St. Louis Chapter.

Boston Sets Up M.I.T. Scholarship



National President George A. Roberts (Left), Watches the Presentation of a \$300 Scholarship Check to the Massachusetts Institute of Technology for a Freshman From the Boston Area, Donated by the Boston Chapter. John Chipman (center), head of M.I.T.'s department of metallurgy, receives the check from W. A. Collins (right), chairman of the Chapter's educational committee. Dr. Roberts spoke on "Advances in Toolsteel Technology" during the meeting. (Reported by M. B. Graham for the Boston Chapter)

Schaefer Notes Importance Of Standards to Industry At Meeting in Calumet

Speaker: Adolph O. Schaefer
Midvale Co.

A.S.M. Vice-President Adolph O. Schaefer, vice-president in charge of engineering and manufacturing, Midvale Co., presented a talk on the "Importance of Standards to Industry" before a meeting in Calumet.

Mr. Schaefer mentioned the early resistance to standardization in industry found in both the employee and the employer. Fear of regimentation, loss of business, monopoly and the "freezing of men's minds" were given as the major reasons for resistance to this movement.

Standardization is not new in industry. Eli Whitney was one of the pioneers in this field. Receiving an order from the Government for a large quantity of muskets, he proceeded with production, using templates, contour milling and numerous other processes common today, to produce a musket with parts interchangeable with any other musket he produced, a feat theretofore unheard of in manufacturing.

The first set of standards officially established was to govern weights and measures and was established in Paris in 1875. In 1902, the first standards in American industry were formed by the founding of the A.S.T.M., and soon after numerous other groups were founded which included individuals, companies, associations of companies, the Government, technical societies and organizations to set up the establishment

Chapter Concludes Machinability Course



L. P. Tarasov, (Right), Norton Co., Presented a Talk on the "Current Aspects of Grinding" During a Course on "Machinability of Metals" Held by Southern Tier Chapter. He is shown with educational chairman, Sam Smith

of standards throughout industry.

Mr. Schaefer cited the standardization of steel by S.A.E. and A.I.S.I. as an outstanding example of the benefits realized in modern industry through standardization. He mentioned the action being taken by A.S.M. in the standardization of heat treating terms. He concluded by stating that, while many standards have been established, there are numerous products and testing methods still to be standardized.—Reported by T. W. Howlett for Calumet Chapter.

A record-breaking total of 420 area machinists, apprentice machinists, engineers and metallurgists attended a series of four lectures on the "Machinability of Metals" recently concluded by the Southern Tier Chapter.

Details of the series were arranged by Sam C. Smith, American LaFrance Foamite Corp., chairman of the educational committee, assisted by Richard Peterson, Ingersoll-Rand Co., R. E. Groethe, J. C. Heymann and W. J. Collins, all of Corning Glass Works. The committee arranged for four well-known men in the machining field to address the group. The program was as follows:

Hans Ernst, director of research and development, Cincinnati Milling Machine Co., on "Physics of Metal Cutting", G. P. Witteman, assistant metallurgical engineer, Bethlehem Steel Co., on "Metal Structure and Machinability", Milton C. Shaw, Massachusetts Institute of Technology, on "Tool Life and Production", and L. P. Tarasov, research director, Norton Co., on "Current Aspects of Grinding".

The following companies were represented at the series: BMT Manufacturing Co.; Chowning Regulator Corp.; Ingersoll-Rand Co.; Brace Tool & Machine Co.; Therm Electric Meters Co.; Cornell University; Eclipse Machine Division; Trayer Products Inc.; Hardinge Bros. Inc.; Hungerford Corp.; Corning Glass Works; International Business Machines Corp.; Westinghouse Electric Corp.; American LaFrance Corp.; Kennedy Valve Co.; J. T. Ryerson & Son and General Electric Co.—Reported by William J. Collins for Southern Tier Chapter.

Talks on Meehanite as a Die Material



E. S. Clark, Chief Engineer, Meehanite Metal Corp., Gave a Talk Entitled "Meehanite as a Die Material" at a Recent Meeting Held by the Western Ontario Chapter. From left are: C. G. Robinson, membership chairman; Mr. Clark; W. Turner, executive committee member; and J. W. Pawley, technical chairman of the meeting. (Reported by J. W. Pawley for Western Ontario)

Talks on Power and Materials in Texas



At a Joint Meeting of the North Texas Chapter and the Local Section A.S.T.M., Norman L. Mochel, President A.S.T.M. and Manager, Metallurgical Engineering, Westinghouse Electric Corp., Spoke on "Power and Materials—Now and in the Future—Some Metals and Materials Problems". Shown are, from left: Jack Turbitt, A.S.M. chairman; Mr. Mochel; J. P. Fowler, A.S.M. secretary; Edwin Joyce, A.S.T.M.; and R. J. Painter, executive secretary A.S.T.M. (Reported by Robert Hopper for North Texas)

Describes Solid Film Lubrication



R. E. Crump, Chief Engineer, Electrofilm Corp., Spoke on the "Mechanics and Application of Solid Film Lubrication" at a Meeting in Wichita. Shown are, from left: L. G. Montre, vice-chairman; Mr. Crump; E. Van Meter, chairman; and J. Ewert, treasurer. (Photograph by C. O. Pate for Wichita)

Speaks at Chicago's Heat Treaters' Night



Peter Payson, Assistant Director of Research, Crucible Steel Co. of America, Discussed "Heat Treatment of Steel—the Metallurgist's Viewpoint" at the Heat Treaters' Night of the Chicago Chapter. Present at the meeting were, from left: C. H. Samans, vice-chairman; Mr. Payson; D. R. Edgerton, technical chairman of the meeting; and J. A. Kubik, chairman

Explains Important Role Of Radio-Isotopes in Metallurgy at Buffalo

Speaker: C. R. Buchanan
Atomic Energy Commission

Radio-isotopes have become an indispensable tool in metallurgical research. C. R. Buchanan, senior field representative, radiological safety branch, Isotopes Division, Atomic Energy Commission, explained to members of the Buffalo Chapter how the metals industry has put these new materials to work in a talk on "Radio-Isotopes in Metallurgy". Radio-isotopes now have over 1000 industrial users, making them the most important peaceful use of atomic energy.

As discrete sources of radiation, radio-isotopes are used in radiography, thickness measuring gages and other instruments, such as liquid level indicators. The essential components of such applications are a radio-isotope to emit radiation and a sensitive element (Gieger counter, film, etc.) to determine how much of the radiation is absorbed by a particular object.

The principal advantages of radio-isotopes in radiography are versatility and penetrating power. Emitters can be placed inside tanks, valve castings, etc., which is not possible with conventional X-ray machines, and the inspection of very heavy thicknesses is much more easily accomplished.

Perhaps the best known use of radio-isotopes has been as tracers. Experiments on friction and lubrication and cutting tool wear are much simpler and more reliable when tracers are used. A Gieger counter will tell very quickly how fast a radioactive piston ring is wearing without the necessity of running the test long enough to make physical measurements of wear.

Using the same technique, radioactive cutting tools can be quickly evaluated. An interesting result of these tests is that only 2 to 3% of the metal worn from the cutting tool is found in the coolant.

Radio-isotopes have also entered the analytical field. Ores of tantalum and columbium are regularly analyzed by "activation analysis". Samples of ore are bombarded to make them radioactive and the quantities of tantalum and columbium can then be determined by identifying their characteristic radiations. This method, of course, is limited to certain elements and cannot compete with other analytical techniques where elements can easily be separated or identified. Tantalum and columbium are very difficult determinations by wet chemistry methods.—Reported by A. E. Leach for Buffalo Chapter.

Titanium and Its Alloys Subject of Montreal Talk

Speaker: Ward M. Minkler
Titanium Metals Corp. of America

Ward M. Minkler, assistant manager of market development, Titanium Metals Corp. of America, presented a talk on "Titanium and Its Alloys" at a meeting in Montreal.

Mr. Minkler sketched the natural occurrence of titanium, its extraction from ore by the chlorine-magnesium sponge process and its properties in pure and alloyed form. The position of titanium as the fourth most abundant metallic metal in the earth's crust indicates the potential use of the metal, once the cost of production has been reduced. The volume of metal produced has risen from 25 tons in 1949 to 6000 tons in 1954, with an expectancy of 25,000 tons within the next two years. At the same time, price has dropped by about 10% per year.

Mr. Minkler pointed out that the aircraft industry is taking up 95% of the available volume of the metal and its alloys, and mentioned the firewall, frame and skins in the Douglas DC-7 engine nacelles and the gun-blast ports and various components on the North American Aviation F-100 airframe as examples. Further applications are found in the guided missile field, where titanium's resistance to fuming nitric acid is particularly useful. Titanium can be employed where its strength-to-weight ratio and corrosion resistance are of advantage, especially at elevated temperatures up to 1000° F.

Mr. Minkler stressed the attention that has been paid to quality during the development of titanium, and envisaged wider applications and further reduction in cost now that attention can be directed more to special fabrication and heat treatment processes and to new types of products such as castings and plated coatings.—Reported by Rafe Sherwin for Montreal Chapter.

Completes Lecture Course On Statistics at Purdue

Irving W. Burr, professor of mathematics, Purdue University, was the lecturer at a series of five talks on "Statistical Methods in Industry and Research" presented at Purdue.

Sixty-nine men enrolled in the course, which included talks on Statistics as Analysis of Data; Significance of Differences; Control Charts; Correlation and Analysis of Variance and Experimental Design. Professor Burr presented the principles and applications of each method.

Members of the Purdue Chapter's educational committee included: Norman A. Parlee, chairman; E. D. Weisert, J. G. Nauss, E. C. Beatty, Doyle Geiselman and G. A. Fritzlen.—Reported by J. J. Phillips for Purdue.

Explains Hot Extrusion Methods in Tulsa



"Hot Extrusion of Titanium and Steel" Was the Title of a Talk Given by G. A. Moudry, Chief Metallurgist, Harvey Machine Co., at a Meeting of the Tulsa Chapter. Present were, from left: George Sykora, chairman; Robert Cottingim, vice-chairman; Mr. Moudry; Paul Ogden, vice-chairman, Bartlesville Section; and Jack Teed (Photograph by J. C. Holmberg)

Saginaw Presents A.S.M. Scholarship



An A.S.M. Scholarship Was Presented to Richard Weadock, St. Mary's High School, Saginaw, Mich., During a Meeting of the Saginaw Valley Chapter. Shown at the presentation are, from left: C. M. Campbell, chairman of educational and student affairs committee; Mr. Weadock; R. S. Haverberg, chairman; and H. R. Wegner, vice-chairman. (Photo—Dow Chemical Co.)

Discusses Controlled Atmospheres



Floyd E. Harris, Consultant for the Dow Furnace Co., Spoke on "Controlled Furnace Atmospheres" at a Meeting Held by the West Michigan Chapter. Twenty-five year certificates were presented during the meeting to Jack Kenney, chairman, Horace Dean, Campbell, Wyant and Cannon Foundry Co., and R. L. Stephenson, district sales manager, A. F. Holden Co. Shown in the picture are from left: Mr. Harris, Mr. Kenney, Mr. Stephenson and Mr. Dean

High-Temperature Metallurgy Explained



N. J. Grant (Center), Professor of Metallurgy, Massachusetts Institute of Technology, Who Discussed "High-Temperature Metallurgy" at a Meeting of the New Jersey Chapter, Is Shown With Louis Luini (Left), Technical Chairman of the Meeting, and J. A. Kearney, New Jersey Chapter Chairman

Speaker: N. J. Grant

Massachusetts Institute of Technology

N. J. Grant, professor, Massachusetts Institute of Technology presented a talk on "High-Temperature Metallurgy" at a meeting of the New Jersey Chapter.

Dr. Grant reviewed developments during the past 10 yr. in iron, nickel and cobalt-base alloys which led to their current use in the high-temperature field. With this background, he then demonstrated, by means of slides, the age-hardening mechanism which contributes to the retention of strength at high temperatures. He showed that the titanium-aluminum ratio in age-hardenable alloys based on nickel or cobalt profoundly influences the high-strength properties and is a factor in the development of stronger alloys.

However, present indications are that alloys based on iron, nickel or cobalt have a practical high-temperature service limit of about 1500 to 1600° F. and other alloying systems must be explored to obtain alloys suitable for service at temperatures above this range.

Molybdenum and a number of molybdenum alloys have this necessary strength for service at 1800° F.; as a matter of fact, some of these materials are stronger at 1800° F. than conventional alloys are at 1500° F. However, catastrophic oxidation of molybdenum in air prevents its use and no foolproof means of protecting the surface has yet been developed.

Also under development are cast chromium-base alloys. Although still in the laboratory stage, some of these which are based on the chromium-nickel system are stronger at 1800° F. than forged S-816. In addition they have adequate room-temperature strength and "as cast" elongations of 5 to 7%. Other chromium-molybdenum-iron alloys are stronger at 1800° F. than some current jet engine alloys are at 1500° F. but unfortunately are brittle.

It appears that ceramic materials, although having excellent high-temperature strength properties, will be

handicapped by inherent brittleness. However, a compromise based on metal-metal oxide wrought alloys offers an interesting field for research. Sintered aluminum powder, known as SAP, is greatly superior to conventional aluminum alloys at high temperatures in stress-rupture and creep properties and points the way for further developments. Using SAP as a prototype, research on the nickel-aluminum and nickel-chromium systems is in progress in an attempt to develop high-temperature materials of this type.—Reported by John L. Everhart for New Jersey Chapter.

Speaks on Ultrasonic Testing Methods at Joint Meeting Held at Oak Ridge

Speaker: Donald C. Erdman

Electro Circuits, Inc.

Donald C. Erdman, founder and president of Electro Circuits, Inc., spoke before the first combined meeting of the Oak Ridge Chapters of Society for Nondestructive Testing and American Society for Metals on "Immersed Ultrasonic Testing".

Mr. Erdman supplemented his talk by the showing of a movie and numerous slides on the applicability of ultrasonics to nondestructive testing. He cited the continued efforts being made to expand the field and explained the use of remote servo-controlled ultrasonic crystal manipulators and new developments on ultrasonic search crystals.

A new technique of "water painting" which allows massive parts not suitable for direct immersion to be tested was described.

Frequencies of from several kilocycles to 25 megacycles are being used which permit a wide range of variation in testing procedures, and a varied sensitivity to varying depths below the metal surface.

Following the talk, Mr. Erdman answered many questions on the applicability of immersed ultrasonic testing to specific cases.—Reported by D. W. Stoffel for Oak Ridge.

Functions of Stress Analysis Explained



Present at a Meeting Held by Tri-City Chapter Were, From Left: W. E. Peterson, Rock Island Arsenal; T. J. Dolan, Who Spoke on "Functions of Experimental Stress Analysis"; and V. H. Vieths, Jr., Chapter Chairman

Speaker: T. J. Dolan

University of Illinois

T. J. Dolan, head of the department of theoretical and applied mechanics, College of Engineering, University of Illinois, addressed the Tri-City Chapter on "Functions of Experimental Stress Analysis".

Mr. Dolan explained various methods and techniques employed in modern research laboratories to determine the significant stresses by experimental methods. He discussed the scope of application, the classi-

fication and limitations of various methods and the importance of a more exact knowledge of localized stresses. He indicated that all pertinent data must be supplied when determining stresses in a unit and that all this data must be accurate. Even with the experienced methods and most significant equipment and careful planning, the results obtained can only be accurate within 15 to 20% for dynamic testing. In comparison, static tests can be made with accuracy within 2%.—Reported by Paul Scherbner for Tri-City Chapter.

Metal Cutting Topic at Minnesota Chapter Meeting

Speaker: H. A. Erickson
D. A. Stuart Oil Co.

Members of the Minnesota Chapter recently heard H. A. Erickson, D. A. Stuart Oil Co., present a discussion on "Metal Cutting".

How cutting oil gets to the bottom of the chip, why chips curl as they do, how long cutting tools last and the speeds which should be used were among the topics discussed.

Slides showing how the chip leaves the work and several possibilities as to how the cutting fluid gets to the base of the chip were shown. Many excellent slides of photomicrographs of the action of the tool, chip and workpiece were also discussed.

The function of the cutting fluid is to regulate temperature, reduce friction, lubricate and act as an anti-weld. These properties in the fluid are regulated by additions of chlorides and sulphides which produce effective lubricants in temperature ranges from 500 to 1800° F. Mr. Erickson described the general types of oils for cutting and machining.

Because of the many applications for cutting and machining oils, extensive testing methods have been devised. Slides of five testing machines which test the ability of various oils to carry loads were shown. These slides also illustrated frictional pressure at graduated pressures.

To select the proper oil for a particular job, it is necessary to consider the character of the oil, material, hardness, feed, depth of cut and tool life. Mr. Erickson explained that tools can fail because of too much cutting oil base as well as not enough.—Reported by Lyle D. Gutsche for Minnesota Chapter.

Describes Coated Abrasives at Worcester



Present at the 25-Year Member Night of the Worcester Chapter Were, From Left: Albert L. Ball, Coffee Speaker, Who Outlined the Development of His Company, the Bay State Abrasive Products Co.; Harold L. Jones, Technical Chairman; and E. E. Oathout, Behr-Manning Division of the Norton Co., Who Spoke on "Coated Abrasives and Their Use in the Metal Industries"

Speaker: E. E. Oathout
Behr-Manning Div.
Norton Co.

"Coated Abrasives and Their Use in the Metal Industry" was the subject of a talk given by E. E. Oathout, production engineer, Behr-Manning Division of the Norton Co., at the Worcester Chapter's 25-Year Member Night.

Mr. Oathout discussed some of the uses of coated abrasives in the early days and how they were confined primarily to the wood and leather industries. With the improved techniques developed during the last 20 years, coated abrasives are now considered capable of doing almost any cutting or polishing job in industry, from rough grinding to precision finishing.

Advantages of coated abrasives

pointed out by Mr. Oathout included less down time for change of set-up, less rework of product and cooler working conditions. The flexibility in the use of coated abrasives permits straight-line finishing over the full area of a flat surface, and eliminates redressing and reshaping. Fine finishes produced by coated abrasive belts are due to the selection of grit sizes available and the even distribution of the grit, which is made possible by the electrostatic alignment of the abrasive particles.

Mr. Oathout pointed out that there are two types of abrasives used in the manufacture of coated abrasives, natural and electric furnace. Flint quartz, garnet and emery are the natural abrasives, while silicon carbide and aluminum oxide make up the electric furnace abrasives. The particular advantages of each type were discussed. Developments in coated abrasives are continuing and more and more grinding and polishing operations will be done with coated abrasive belts.

Mr. Oathout discussed control features in the making of coated abrasives, such as viscosity of glue, size of abrasive, weight and grinding tests. He stated that in 1954, 80,000 miles of coated abrasive were manufactured by his company. A 9-in. wide coated abrasive belt on a centerless grinder has removed 1 lb. of metal per min.

Manufacturing processes and many new and different applications for coated abrasives were illustrated with a 16-mm. color-sound film at the close of Mr. Oathout's talk.

Chairman J. C. Danec read the list of 20 25-year members and presented a 25-year sustaining membership to the Johnson Steel & Wire Co. He noted that the Chapter, which was formed in 1921 with 12 members, now has a roster of 225 members, with 75 companies holding sustaining memberships.—Reported by E. F. Grady for Worcester.

Texas Western Awards A.S.M. Scholarship



William Boisvert, a Sophomore Metallurgy Student at Texas Western College of the University of Texas, Was Recently Awarded an A.S.M. \$400 Scholarship. Pictured are Mr. Boisvert receiving the award plaque from J. C. Rintelen, Jr., chairman of the College's department of mining and metallurgy

Some Metallurgical Aspects of Welding Outlined at Meeting

Speaker: Robert H. Aborn
U. S. Steel Corp.

Robert H. Aborn, director of fundamental research laboratory for the United States Steel Corp., recently addressed a joint session of the Northeast Pennsylvania Chapter and the Susquehanna Valley Section of the American Welding Society on the subject, "Metallurgical Aspects of Welding".

Dr. Aborn explained the basic fundamentals of welding and listed the following principal metallurgical phenomena in welding associated with decreasing temperature: Hot cracking, distortion, grain growth, transformation, aging, residual stresses and cold cracking.

He pointed out that weld metal protected from the atmosphere has better mechanical and physical properties because of a smaller amount of dissolved and occluded oxygen and nitrogen. To illustrate this point, the speaker presented data showing that weld metal from bare electrodes contained at least 20 times more oxygen and nitrogen than weld metal deposited by submerged arc. The presence of hydrogen in the weld metal is objectionable and is considered responsible for the "fish-eyes" in tensile fractures. Hydrogen can also form cold cracks in hardenable base metals so that precautions are necessary.

Hot cracks, which occur in the weld metal, generally during solidification, are the result of excessively high shrinkage stresses. The possibility of these cracks occurring can be reduced through the use of welding alloys having a narrow solidification range, and in mild steel by root passes which are heavy enough to withstand the stresses. Sulphur is thought to cause porosity, which can be minimized through the use of low-hydrogen electrodes. The speaker cautioned that in joining high alloy steels to those of low alloy content, the welder should take into account the differences in contraction between the materials. The use of low-carbon ferritic electrodes was given as one means of minimizing migration of carbon to form a brittle high-carbon layer when joining austenitic and ferritic structures.

In introducing the effects of the cooling rate on the weld, he listed several factors which increase the rate of heat input and the rate of heat dissipation. The cooling rate determines the nature of the structure of a given weld and, therefore, its properties. Gas welding has a slow cooling rate of 50 to 200°F. per min., arc welding an intermediate

cooling rate of 400 to 4000°F. per min., and spot welding has the fastest cooling rate, 10,000 to 60,000°F. per min. through the most important region of transformation.

The transformation which takes place in the weld of one steel analysis for a given cooling rate may be very much different than the transformation which occurs in another steel for the same cooling rate. As the alloy or carbon content of the steel is increased, the transformations are delayed so that even slow or intermediate cooling rates can develop hard and brittle structures. The process of preheating at 600°F. slows the cooling rate sufficiently in many cases to form more desirable structures.

Plain carbon steels with a carbon content below 0.30% are relatively easily weldable; those steels with

from 0.35 to 0.50% carbon are welded with caution and preheat and stress relief are preferred; steels above 0.50% carbon are difficult to weld, and preheat and stress relief are both necessary. Residual stresses are important when (1) dimensional stability is critical with machining after welding; (2) the part is subject to alternating stresses; or (3) the weldment is to be in a stress-corrosion inducing environment. The improvement in properties shown by stress relieved specimens is the result of the elimination of hydrogen, the relief of strain aging and the tempering of the hardened structure.

The speaker emphasized that proper design is a highly important but often neglected factor in the performance of welded structures.—
Reported by Alfred J. Babecki for Northeast Pennsylvania Chapter.

Describes Industrial Uses of Atoms



Oscar M. Bizzell, Chief, Technical Developments Branch, Isotopes Division, Atomic Energy Commission, Spoke on "Industrial Uses of the Atom" at a Meeting of the Peoria Chapter. Present at the meeting were, from left: James W. Cantwell, chairman; Mr. Bizzell; Dale J. Wright, general superintendent, and Tom H. Spencer, assistant metallurgist, Caterpillar Tractor Co.

Speaker: Oscar M. Bizzell
Atomic Energy Commission

At a meeting of the Peoria Chapter, Oscar M. Bizzell, chief, technical developments branch, Isotopes Division, Atomic Energy Commission, spoke on "Industrial Uses of Atom".

Isotopes are being made available to qualified persons in industry today to aid in the solution of many difficult production problems. One type of investigation uses parts exposed to the radiation of an atomic pile which then might be tested to detect minute amounts of wear. The procedure permits continuous measurement during the test. An example of this was given where the piston rings of an internal combustion engine were treated and then tested in an engine. The radioactivity in the lubricating oil gave a continuous gage of wear characteristics.

The measurement of reflected or absorbed radiation is being used in other applications to assist in maintaining control over many continuous industrial processes. Such applica-

tions include the control of thickness of paper by connecting one measuring device to suitable regulating equipment and making automatic adjustments to the papermaking rolls. A similar application is used in the tobacco industry to control the firmness of cigarettes.

Additional applications include the measurement of fluid levels in hot, pressurized or corrosive processes, measurements of slit depth in reservoirs and the measurement of surface coatings.

Mr. Bizzell stated that radioisotopes hold many keys to present-day industrial secrets and speculated they will soon be as familiar to industrialists as electricity is today.—Reported by J. G. Frantzreb for Peoria.

publishes Transactions, a bound volume containing the papers and discussions presented at the annual convention, together with reports of the activities of the Society.

Talks on Free-Machining Cold Finished Bars



T. D. Taylor (Right), Bliss & Laughlin Steel Co., Who Discussed "Free-Machining Cold Finished Bars" at a Meeting of the Springfield Chapter, Is Shown With E. G. Brogan, Technical Chairman of the Meeting



Ridgway Cook, Chairman of the Springfield Chapter, Is Shown Presenting a 25-Year Certificate to M. J. Gorman, (Right), Heat Treat Supervisor, Moore Drop Forge Co., During a Meeting Held Recently by the Chapter

Speaker: Thomas D. Taylor
Bliss and Laughlin Steel Co.

Speaking before the **Springfield Chapter**, Thomas D. Taylor, metallurgical engineer, Bliss and Laughlin Steel Co., traced the "Development, Manufacture and Uses of Free-Machining Cold Finished Bars".

In 1926, the only two free-machining steels were SAE 1112 and SAE 1120. The first of these could be cut at from 85s.f.m. to 140s.f.m., but machinability was not consistent or dependable. The openhearth 1120 was soft, gummy and produced parts having poor finish. There was no free-machining through hardening steel, although SAE 1040 was eventually to meet this need.

Development work at this time aimed at improvement of machinability by making a steel which could withstand deeper feeds rather than higher spindle speeds. Deeper feeds, however, were known to produce greater chip pressure and hotter chips, both of which tendencies promote formation of a built-up edge and its attendant poor surface finish. Therefore, work was aimed at minimizing the formation of built-up edges. Improvements along these lines were accomplished over the years, Mr. Taylor stated, by increasing the sulfur and manganese contents so as to produce more soft, nonabrasive inclusions in the steel. Further improvement was achieved in Bessemer steels by increasing the blow by about 20 sec., so as to reduce the silicon content and thereby lower the number of hard abrasive silica inclusions. At the same time the nitrogen content rose slightly, reducing the ductility of the steel and minimizing built-up edge forming tendencies.

It was definitely established that

the best grades of steel for free machining should not contain more than 10 points of carbon. Another important achievement was the successful addition of lead, accomplished in 1938. World War II, for all practical purposes, stopped development and production of the leaded steels in this country, but production for domestic consumption was resumed about 1950. Lead is added as a stream of fine shot, injected from an air gun into the stream of molten steel during teeming. Constant checks must be made to insure that segregation does not occur. If segregation does occur it will do so in the bottom of each ingot, and specimens are taken from the bottom of each ingot for quality control. Lead contents as high as 0.48% Pb are in use today.

Nitrogen and phosphorus are added in the ladle to the present SAE 1112 to reduce ductility and the built-up edge. The addition of nitrogen is accomplished by adding bagged NH_4NO_3 .

When the carbon content of a steel reaches a certain value, heat treatment is needed to supplement the effects of lead and sulfur in steels for maximum machinability. Up to 0.50% C., the microstructure should consist of blocky pearlite; from 0.50-0.70% C., coarse pearlite with incipient spheroidization is recommended.

Leaded carbon steels cost about \$12 more per ton than lead-free steels. Leaded alloy steels cost about \$18 more per ton. The presence of lead does not noticeably affect mechanical properties of steels with tensile strengths up to about 200,000 psi. and Brinell hardness up to 400, nor does lead adversely affect steels used for carburizing or nitriding, and it has no effect on hardenability. Weldability is also

unaffected by the use of leaded steels.—**Reported by C. A. Keyser for Springfield Chapter.**

Gives Concepts of Plastic-Viscous Flow in Metals

Speaker: Henry Eyring
University of Utah

Henry Eyring, dean of the graduate school, University of Utah, spoke on "Modern Concepts of Plastic and Viscous Flow in Metals" in Utah.

Dr. Eyring's talk dealt with the use of the rate process equations for which he is well known. Melting was described as a process of putting holes in crystals so that slipping is made particularly easy. During this process, there is an increase of volume of about 10% in nonmetals and 3% in metals.

Perfect crystals of metals flow with extreme difficulty, but when imperfections, such as holes or dislocations, are present, flow is much easier. When soft metals, those which flow easily, are subjected to a slight stress, movement takes place. Such movement may be very slow and is known as creep, or relatively rapid and is known as slip. The rate is dependent on the hyperbolic sign term in the rate equation and the other constants in this equation. The equation comes from statistical mechanics and represents the difference in the frequency and magnitude of the forward and backward oscillations of the individual atoms in the crystal. Under conditions of equilibrium (no stress), this difference is zero, but when any stress is applied, the difference is not zero and flow takes place in the direction of the stress forces at a rate commensurate with their magnitude.—**Reported by H. Edward Flanders for Utah.**

Trends in Engine Progress Forecast at Meeting of Ottawa Valley Chapter

Speaker: D. F. Caris

Research Laboratories Division

"Future Trends in Engine Progress" was the topic of a talk given by Darl F. Caris, head, automotive engines department, Research Laboratories Division, General Motors Corp., at a meeting of the Ottawa Valley Chapter.

Mr. Caris discussed future trends in engine development in relation to trends developed in the past, showing the tendency to higher compression ratio and higher octane number and their relationship to better performance and economy. Three methods were outlined whereby the primary interest, better fuel economy, could be achieved. These were higher octane numbers, better engine transmission combinations and weight reduction.

Better fuel economy will come from increasing the compression ratio of the engine and increasing the octane number. Higher octane fuels are being developed to keep pace with higher compression ratios with no undue rise in cost of the fuel. Higher octane numbers can be mechanically built into a car to give better economy.

Better engine transmission performance can give tremendous economy increases, with the incentive for research being the "ideal" transmission which will give maximum efficiency at all engine speeds.

Weight reduction of engines, allowing weight reduction in the frames, could increase economy. Cost of lighter materials is too high at present to allow their use entirely in present-type engines.

Mr. Caris discussed high-horsepower engines, emphasizing the narrower range of gear operation and lower axle ratios which can be used, resulting in better fuel economy.

Higher horsepower also allows increased safety by improving high-speed acceleration.

Mr. Caris mentioned the possible application of the gas turbine engine and expressed the view that it would not be suitable for automobiles unless it could offer something much better than can be foreseen offered by the piston engine, regarding both performance and economy. The gas turbine engine may have some present use for trucks and buses, and maybe for automobiles some 15 years from now.—Reported by D. A. Scott for Ottawa Valley Chapter.

Points Out Developments Made in Foundry Industry

Speaker: H. G. Schlichter

Beardsley and Piper Co.

H. G. Schlichter, vice-president and sales manager of the Beardsley and Piper Co., spoke before the Utah Chapter on "New Developments in the Foundry Industry".

Mr. Schlichter reviewed many of the practices used in the making of molds, beginning with almost primitive methods. He explained the savings in time, money and efficiency which have been accomplished by the use of modern equipment such as high-speed mullers, sand slingers and plastics. Careful control of sand properties has resulted from the use of rapid operating equipment which prevents much of the change in properties of sand when drying.

Special attention was given by the speaker to core flowing and the speed with which cores of moderate size can be made by this method.

Two movies illustrating the talk were shown.—Reported by H. Edward Flanders for Utah Chapter.

Montreal Hears LaQue on Corrosion



J. U. MacEwan, Chairman, Frank L. LaQue, Guest Speaker, and J. J. Waller, Vice-Chairman, Discuss Mr. LaQue's Talk on "Some Apparent Anomalies in Corrosion" After a Meeting Held Recently by the Montreal Chapter

Speaker: F. L. LaQue

International Nickel Co.

At a recent meeting of the Montreal Chapter, F. L. LaQue, vice-president and manager of the development and research division, International Nickel Co., talked on "Some Apparent Anomalies in Corrosion".

Mr. LaQue stressed the erroneous conclusions which may be drawn from incomplete evaluation of all factors affecting corrosion. Seemingly inconsistent data can often be resolved when further study reveals features previously not taken into account.

Mr. LaQue explained the startling difference in results in timeline studies when using small panels at different levels and insulated, one from the other, as against one large panel. Another example is the in-

correct conclusions which may be drawn from the electromotive series as to the damage resulting from galvanic coupling of two metals without consideration being given to the polarizing tendencies of the metals. Mr. LaQue quoted an example from his early experience where it was thought that nitric acid in the presence of an oxidizing agent would be damaging to Monel, but subsequent investigation revealed this true only for the lower oxides of nitric acid and, in cases, involving a dichromate solution, such oxides are absent and damage does not occur.

Mr. LaQue emphasized the great need for detailed study and investigation of a vast range of specific materials and corrosion conditions to fill the gaps in our present knowledge of the subject.—Reported by Rafe Sherwin for Montreal Chapter.

Outlines Process of Chromic Acid Anodizing of Aluminum

Speaker: G. E. Best

Mutual Chemical Co. of America

An outline of "Chromic Acid Anodizing of Aluminum" was given by G. E. Best, Mutual Chemical Division, Mutual Chemical Co. of America, at a meeting in Minnesota.

Mr. Best outlined the practices of anodizing and explained that anodizing was the opposite of electroplating. He stated that anodizing is actually an oxidation process which provides excellent corrosion resistance with low operating cost, and is accomplished with low current density, low power consumption and simplicity of bath control. Colored finishes may be obtained on chromic acid anodized aluminum and its alloys by dyeing red, yellow, green and blue, for decorative purposes, or for identification purposes.—Reported by Lyle D. Gutsche for Minnesota.

Young Fellows Hear Talk on Atomic Energy



Part of the Large Group of the Members of the Pittsburgh Chapter Who Attended Young Fellows Night to Hear W. E. Johnson, Westinghouse Electric Corp., Present a Discussion Entitled "Outlook for Atomic Energy"

Speaker: W. E. Johnson
Westinghouse Electric Corp.

At the Young Fellows Night Meeting of the Pittsburgh Chapter, W. E. Johnson, assistant manager of industrial atomic power, Westinghouse Electric Corp., presented an "Outlook for Atomic Power".

The world's available energy from coal, gas, oil, water and other sources was reviewed by Dr. Johnson. With the increased demands for energy, conventional sources will be depleted within the next 100 years; however, the available atomic energy greatly exceeds that of conventional energy and, if we wisely utilize this new source, there will be ample energy for many more centuries.

The means of obtaining power

from atomic energy were reviewed. Numerous material and design problems are encountered in the building of reactors for converting atomic energy to steam or electricity. Some of the problems encountered in the construction of the engine for the submarine Nautilus and the more recent work on the construction of the atomic electrical power plant for Shippensburg were discussed in a general way.

The after-dinner speaker, Edward Baker, football coach at Carnegie Institute of Technology, spoke on "Problems of Small College Football". He emphasized the need for small college football and related many humorous incidents experienced in his career as a coach.—Reported by R. Smith for Pittsburgh.

Talks on Chromium Plating At Joint ASM-AES Meeting

Speaker: Fred Fulforth
United Chromium, Inc.

Fred Fulforth, sales engineer, United Chromium, Inc., spoke at a joint meeting of the York Chapter and the Lancaster Branch of the American Electroplaters Society on "Chromium Plating and Wear and Corrosion Resisting Uses".

Mr. Fulforth discussed the reasons for chromium plating and showed a number of chromium-plated parts. Improved wear resistance, reduced friction, salvaging of worn parts, corrosion resistance and improved lubrication can be obtained by chromium plating, he stated.

An example of improved wear resistance by chromium plating was the introduction of porous chromium plate during World War II. Failure of the cylinder walls on submarine diesel engines was reduced by the use of porous chromium plate having a network of fine etching cracks.

These cracks act as a carrier for the lubricant. The use of a photo-etching process followed by chromium plating as a means of obtaining an irregular surface which will hold a lubricant was also discussed.

Mr. Fulforth described the development of new plating baths to obtain a harder chromium plate. The hardness of the plate has been increased approximately 20%, while maintaining a fine grain size and good ductility. The use of the Bierbaum microcharacter method for measuring the hardness of the chromium plate was explained. This method consists of making a scratch with a preloaded diamond point and measuring the width of the scratch. The effect of exposure to temperature on the hardness of the chromium plate was shown graphically, with a marked drop in hardness occurring at about 300° C.

The effect of chromium plating on the fatigue life of the base metal was illustrated with data accumulated on SAE 4130 steel. Improvements in chromium plating baths

and procedures made it possible to reduce the loss in fatigue properties from approximately 20 to 5%.

In general, Mr. Fulforth felt that the most desirable chromium plating bath should produce a plate having a fine grain, high hardness, good leveling action to minimize the tendency to build-up on high points and a minimum of adverse effect on the fatigue properties of the base metal.

—Reported by L. A. Hurwitz for York Chapter.

Describes Induction Heat Treating Principles at Meeting of Notre Dame

Speaker: J. F. Libsch
Lehigh University

Joseph F. Libsch, associate professor of metallurgy, Lehigh University, gave a talk on the "Metallurgical Aspects of Induction Heating" at a meeting of the Notre Dame Chapter.

Dr. Libsch first explained the electrical requirements of equipment for induction heating. Induction heating starts on the outside of the piece to be heated; therefore, the thickness or diameter of the piece will determine the electrical requirements of the heater.

Any metal that will conduct electricity can be induction heated. The heating time is very rapid and the time at temperature can be zero. The alloys that form carbides must be heat treated differently from those that do not form carbides. The speaker mentioned that the structure of the metal prior to heat treatment is very important on the final mechanical properties of the part.

Dr. Libsch had a very impressive display of parts made by the induction heating process which he referred to frequently to illustrate his talk.—Reported by R. C. Pocock for Notre Dame Chapter.

Officers of Northwest Chapters Hold Joint Meeting



Present at the Joint Meeting Held Recently by the Northwest Chapters A.S.M. Were, From Left: James E. Gustafson, Bethlehem Pacific Coast Steel Corp.; James Bates, Hyster Co.; Clinton R. Lundy, Kaiser Aluminum and Chemical Corp.; A. H. Roberson, Branch of Process Metallurgy, U. S. Bureau of Mines; L. F. Miller, Re-

porter for the Conference; W. L. Slosson, Boeing Airplane Co.; John Stokes, Throwaway Bit Co., Ltd.; L. P. Carter, Production Supply Co. Ltd.; Francis M. Krill, Kaiser Aluminum and Chemical Corp.; D. S. Bennett, Rainway Irrigation Co.; and L. D. Turner, General Electric Co. (Photo by Lawrence Chockie)

At a meeting held in the Olympic Hotel in Seattle, Wash., officers from each of the five Northwest Chapters discussed the standing and progress of their chapters since their meeting a year ago. A. H. Roberson, chairman of the conference, divided the agenda into three main topics for discussion: (1) Appraisal of meetings and speakers, attendance and publicity for the technical meetings; (2) Education courses and chapter membership; (3) Future plans, including: circuit speakers, suggestions for speakers to improve their presentation, suggestions for subjects, education program, student activities, achievement and teaching awards.

Attending the conference were: W. L. Slosson and C. R. Lundy, representing Puget Sound Chapter; J. E. Gustafson, James Bates and A. H. Roberson, Oregon Chapter; L. P. Carter and John Stokes, British Columbia Chapter; F. M. Krill and Dallas S. Bennett, Inland Empire Chapter and L. D. Turner and L. J. Chockie, Columbia Basin Chapter.—**Reported by Lawrence J. Chockie, Columbia Basin Chapter.**

Discusses Microstructure And Fracture at Meeting Of Saginaw Valley Chapter

Speaker: John C. Fisher
General Electric Co.

A record crowd turned out to hear John Fisher, manager of physical metallurgy section, research laboratory, General Electric Co., discuss "Microstructure and Fracture" at a meeting in Saginaw Valley.

The metallurgist worries about fracture because it shows up poor design and reduces the capacity of a part to absorb energy. He is interested not in strength alone, but in strength and ductility.

Factors which affect the brittleness of metals are temperature, grain size, speed of stress application, size of part, crystal structure and such metallurgical factors as grain boundary films and low-strength inclusions.

Griffith, working with glass in the 1920's, laid the groundwork for fracture studies. Working with surface and strain energies, he was able to predict the stress required to initiate cracks in glass. However, unlike glass, fractures in metals are complicated by plastic flow. Plastic flow always precedes fracture. Low of General Electric found that, with plastic flow, the grains crack. He

developed a relationship for stress and grain size which enabled him to predict brittle fractures.

In spite of the work already done, many problems remain to be solved. Questions arise as to how flow affects crack formation, why face-centered cubic metals are ductile, the role of grain boundaries and high temperature in cracking, and fatigue. Dr. Fisher stated that the metallurgist is now on the right track in the study of metal fractures.

Prior to Dr. Fisher's talk, a short movie on "Precision Investment Casting" was shown.—**Reported by Nicholas Sheptak for Saginaw Valley Chapter.**

Kentucky Student Receives Scholarship



Shown Presenting an A.S.M. Scholarship Plaque to George D. Ravencraft (Right), University of Kentucky Student, Is F. F. Dietsch, Chairman of the Public Relations Committee, During a Meeting of Louisville Chapter

Outlines Engineering Aspects of Stainless Steel at Ottawa Valley

Speaker: J. P. Ogilvie
Shawinigan Chemicals Ltd.

"Engineering Aspects of the Stainless Steels" was the subject of a talk given by J. P. Ogilvie, development engineer, Stainless Steel and Alloy Division, Shawinigan Chemicals Ltd., before a meeting of the **Ottawa Valley Chapter**.

Dr. Ogilvie discussed the reasons for corrosion resistance of stainless steels in relation to their composition and AISI-ASTM classification numbers. A brief review of the main classes, martensitic, ferritic and austenitic, was given and it was stated that, although the wrought and cast compositions sometimes differ somewhat, for equivalent types their corrosion behavior is similar.

Many of the general corrosion conditions were reviewed, such as oxidizing and reducing solutions and the effect of temperature and pressure, in relation to the iron-chromium-nickel diagram. Examples of applications in which stainless steel castings were used were given by the speaker.

Dr. Ogilvie discussed intergranular corrosion, its causes and prevention, and the effects of stabilization. He also discussed the heat resistance of stainless steels in relation to the iron-chromium-nickel diagram. He showed how, under straight oxidizing conditions, increasing temperature of the application required the beneficial effect of increasing nickel content, whereas under sulphidation conditions, lower nickel contents were necessary.

Dr. Ogilvie illustrated many of the general heat resistance applications. —**Reported by D. A. Scott for Ottawa Valley Chapter.**

A.F.S. Announces Convention

A total of over 100 technical papers will be presented at about 50 sessions during the Annual Convention of the American Foundrymen's Society, to be held in Houston, Tex., from May 23 to 27, 1955. In addition, a series of shop courses has been scheduled and nine round-table luncheons will be held. Emphasis will be placed on practicality as well as broadest possible coverage of the latest technological developments in the foundry industry of interest to top management, metallurgists and operating foundrymen throughout the meeting.

The complete, detailed program of the Convention will be printed in the May issue of the *American Foundryman* and the list of preprints of the papers presented at the Convention will be made available a short time thereafter.

Indianapolis Hears Heat Treating Hints



Members and Guests of the Indianapolis Chapter Join D. R. Edgerton (Second From Left), Lindberg Steel Treating Co., in a Chat After the Technical Session. Mr. Edgerton presented a talk entitled "Heat Treating Hints"

Speaker: D. R. Edgerton
Lindberg Steel Treating Co.

Members of the **Indianapolis Chapter** heard a talk on "Heat Treating Hints" by D. R. Edgerton, Lindberg Steel Treating Co., recently.

The basic requirement of industry is to provide the best possible part at the lowest cost. To fulfill this requirement, there must be extensive cooperation between each echelon concerned with the manufacture of a product. Heat treatment is an expensive operation, due to costly furnaces, quenching baths and apparatus for controlling the atmosphere in the furnace. Temperature recording and controlling equipment is also expensive. Therefore, it is necessary to utilize all available theoretical and practical knowledge.

The heat treater's role in the manufacture of a product is made much easier by the use of various heat treating aids, such as TTT charts, pyrometer charts, hardenability curves and ladle analysis, all of which help to minimize product loss during heat treatment.

The manufacturers of heat treating equipment are doing a marvelous job providing modern equipment—a heavy contributing factor to successful heat treating. The ability to control the carbon potential and carbon restoration are perhaps the greatest contributions to the science of heat treating in recent years.

Thousands of dollars are wasted each year because tools and other articles, which are expensive to machine, are lost during heat treatment. Such loss, or waste of material, can usually be prevented by the intelligent selection of the proper steel and by avoiding in design sharp corners and re-entrant angles where stresses may be concentrated. The design engineer plays an important role in the successful heat treatment of tools. He is often able to cut corners to save cost and thus forestalls failures later in heat treatment. Design engineers should re-

member that, from the standpoint of stress, the ideal section is a sphere and they should design a balanced section to provide adequate safety factors.

Size change is an important factor in the heat treatment of dies, gages, tools, etc. This factor has been somewhat minimized by the practice of double heat treatment, preheating and proper steel selection. Mr. Edgerton recommended that larger sections be double quenched to minimize distortion and simultaneously maintain more reasonable tolerance limits. When adequate facilities are available, straight marquenching is the ideal procedure.

Pretreatment is applicable to small parts as well as large sections and will tend to produce more reasonable tolerance limits. It also provides a smoother surface for machining. —**Reported by Robert Fesko for Indianapolis Chapter.**

Explains Factors Which Affect Weldment Behavior

Speaker: W. S. Pellini
Naval Research Laboratory

"Factors Which Determine the Performance of Weldments" was the title of the technical talk presented before **Milwaukee Chapter** by W. S. Pellini, superintendent, Metallurgical Div., Naval Research Laboratory.

Mr. Pellini explained the role of the weld, heat affected zone and the prime plate in determining the performance of weldments. Clarification of differences in the weldability problems of carbon and high strength alloy steels was also made. The underlying theme of Mr. Pellini's discussion was that the notch ductility of the steel used greatly determines the performance of the weldments. The strength of armor steel plate and the effect of temperatures on ships of welded construction were also discussed and illustrated with slides. —**Reported by E. H. Schmidt for Milwaukee Chapter.**

Students Hear Talk on Stainless



Speaker: D. C. Buck
United States Steel Corp.

"Metallurgical Aspects of Modern Stainless Steels" was the title of the talk presented at Milwaukee Chapter by D. C. Buck, metallurgical engineer in charge of stainless steel division, United States Steel Corp.

Mr. Buck covered the manufacturing processes currently used in producing the various types of stainless steels. He discussed the structural, chemical, physical and mechanical properties of stainless, with particular emphasis given to various types of corrosion encountered in service and the mechanism used in combating these effects. New developments, including substitutions for nickel in austenitic stainless steels, precipitation hardening alloys and stainless steel extrusions were also discussed.

This meeting was designated as Milwaukee Chapter's Students Night. Twenty-two students and three faculty members of University of Wisconsin, and 17 students and one faculty member of Marquette University were guests of the Chapter.—Reported by E. H. Schmidt for Milwaukee.

Engineering Applications Of High Carbon Steels

Speaker: R. L. Wilson
Timken Roller Bearing Co.

Ralph L. Wilson, director of metallurgy, Timken Roller Bearing Co., addressed the Northeast Pennsylvania Chapter on the subject, "High Carbon Steel in Engineering Applications". Mr. Wilson defined toolsteel as being any steel having a carbon

Above, Students From Marquette University, and Below, Students From University of Wisconsin, Were Guests of Milwaukee Chapter at a Meeting During Which D. C. Buck, U. S. Steel Corp., Talked on "Metallurgical Aspects of Stainless Steels"

content of about 0.50% or more used for tool purposes. The first toolsteels made were of the plain carbon, water hardening type. In later steels, the manganese content was raised to make them oil hardening, and eventually other alloying elements were added. Thus, high carbon steels were primarily known as toolsteels but they had no engineering applications.

The first high carbon steel to be used in an engineering application was ball bearing steel, which contained about 1% carbon, 1.5% chromium, and 0.5% manganese. In this application, great strength and wear resistance were important. Ordinarily, high wear resistance is the most desirable property in toolsteels, and high toughness the most desirable in engineering steels. High carbon steels in engineering applications are used at something less than their hardest condition. Low carbon steels in engineering applications are given the properties of a higher surface carbon content by the carburizing processes. The popularity of the carburizing steels has grown to the extent that in the first quarter of 1954 only 2% of all alloy steel produced was of the high carbon-chromium type, whereas 21% was of the carburizing type. The auto

industry uses about one-third of all engineering alloy steels produced, and of this amount, one-half is of the carburizing grades.

Mr. Wilson stated that induction hardened plain high carbon steels are replacing the simple and alloy carburizing steels in many engineering applications. The surface of plain high carbon steels can be induction hardened to high values, but the higher hardenabilities of the alloy steels produce a deeper hardening effect. Alloying elements in steels for induction hardening must be specially selected to contribute to the hardenability of the steel because, in the short induction heating cycles, they must go into solution rapidly.

The speaker went on to explain in general terms and demonstrate with slides the action of alloying elements in steel and how they alter the iron-iron-carbide phase diagram and, therefore, vary the heat treatments. He pointed out that an excess of carbon as carbide particles in the high carbon steels nucleates transformation and lowers hardenability. Optimum hardenability is attained in a steel with just sufficient carbon to saturate the iron. When excess carbide is present, a spheroidize annealed structure produces a higher hardenability than a normalized structure after normal austenitizing.—Reported by A. J. Babecki for Northeast Pennsylvania Chapter

Use of Radioactive Isotopes by Industry

Speaker: C. M. Summers
General Electric Co.

C. M. Summers, manager of the Fort Wayne Laboratory of General Electric Co., delivered an informative talk on "What Industry Is Doing With Radioactive Isotopes" to members and guests of the Terre Haute Chapter at a recent meeting.

He explained, in simplified terms, atomic structure, fission and radioactivity to give the listeners a little background in atomic physics, and then described some of the industrial applications of radioactive isotopes.

Applications include wear testing of lubrication in combustion engines by the use of radioactive silicon in piston rings and steels and the detection and measurement of this material in the oil system by a Geiger counter. In this manner, results that would require months in a normal test can be obtained in a few hours. Mr. Summers then discussed some of the thickness gages in use today which employ counters and radioactive materials, and the use of Cobalt-60 instead of high voltage X-ray equipment for X-ray inspection.

—Reported by Karl E. Fenrich for Terre Haute Chapter.

Processing and Uses of Toolsteels Discussed at Meeting in Terre Haute

Speaker: S. M. DePoy

Dayton Forging & Heat Treating Co.

"Toolsteels — Application, Specification and Processing" was the topic of the talk by Stewart M. DePoy, metallurgist and heat treat superintendent, Dayton Forging and Heat Treating Co., before a meeting of the Terre Haute Chapter.

Mr. DePoy outlined the AISI and SAE toolsteel designations, with special emphasis on high speed toolsteels, including the tungsten and molybdenum grades. He pointed out that the molybdenum grades have all but replaced the tungsten grades, with over half of the current consumption of high speed toolsteel being of the M-2 variety.

At the inception of the molybdenum high speed steels, during World War II, they were looked upon as inferior, but they were accepted because sufficient tungsten was not available. However, it has now been quite well established that, for the average machining operation, the molybdenum steels are even superior to the tungsten grades when properly heat treated.

The use of the higher carbon molybdenum steels, M-3 and M-4, is on the increase as they have very desirable characteristics where extreme abrasion resistance is a necessity. Where extreme toughness of tools is the desirable element, the tungsten grades still have the edge.

Mr. DePoy pointed out that it is highly desirable for the heat treater to know as much as possible about the application and the exact analysis of the toolsteel to assist in the selection of the best processing for a given tool. In many cases, the heat treater can assist the small shop operator in the selection of the best steel for a given application.—

Reported by Karl E. Fenrich for Terre Haute Chapter.

N. W. Pennsylvania Hears Titanium Talk



Northwestern Pennsylvania Chapter Members Heard T. W. Lippert, Titanium Metals Corp. of America, Speak on the "Application and Metallurgy of Titanium and Its Alloys". Shown are, from left: E. E. Hall, vice-chairman; Willard Roth, chairman; Mr. Lippert; and H. F. Bartell, program chairman

Speaker: T. W. Lippert

Titanium Metals Corp. of America

At a recent meeting of the Northwestern Pennsylvania Chapter, Thomas W. Lippert, manager of sales and technical service, Titanium Metals Corp. of America, presented a talk on "Application and Metallurgy of Titanium and Its Alloys".

Mr. Lippert discussed many aspects of the industry from ore reduction to eventual end use of rolled and forged titanium parts.

He emphasized that the titanium industry is still in its infancy, being actually only 5 yr. old. However, technological advance has been tremendous, due to the rapid development of supersonic planes and jet engines, in the manufacture of which titanium fills requirements met by no other known metal. In fact, further development of jet engines with significantly greater thrusts than presently possible could hardly be projected without heat treatable titanium alloys possessing high yield strengths combined with light weight, excellent corrosion properties and intermediate temperature resistance.

Considerable discussion centered on the problem of hydrogen embrittle-

ment. Mr. Lippert pointed out that the embrittlement problem cropped up as an inconsistency. Sheets rolled from billets with apparently identical treatments varied widely in their physical properties. When the cause was found to be excess absorbed hydrogen, specifications were drawn to keep it below 0.015%. Consequently, the manufacturer developed the process of vacuum melting to drop hydrogen in ingot to a very low level. There is also a growing art of vacuum annealing finished stock, primarily as a recovery operation, to reduce hydrogen to specification levels. Present equipment can drop hydrogen in finished metal to 0.005 to 0.008% by annealing at 1200° F. at a 5-micron vacuum.

In common with all new arts, seemingly difficult problems have been encountered. In the earlier days, the problem of machinability was rather easily solved by high pressure lubrication right at the cutting face of tools. Another early problem was found to be difficult weldability. However, alloy titanium is now being welded on a routine basis.

Although most of the titanium now being produced is for military purposes, a significant amount is also being used in civilian aircraft. Although the metal is still quite expensive, due to relatively low production and ever-tightening specifications, use is rapidly becoming economically feasible because of its unique properties.

Mr. Lippert predicted that continuing technical development in the next 5 yr. might well reduce the price to one-half the present price. This would widen the civilian market enormously, especially in the chemical processing industries.—Reported by A. F. Snow for Northwestern Pennsylvania Chapter.

Pueblo Honors National President



National President George A. Roberts Gave a Talk on "Toolsteels—New Developments and Applications" at a Meeting of the Rocky Mountain Chapter, Pueblo Group. At the speaker's table were, from left: John R. Zadra; Harley H. Hartman, chairman; Mr. Roberts; and C. E. Bowman, vice-chairman

has not increased its dues (\$10.00 per year) since it was founded.

Why Metals Fail at High Temperatures



F. B. Foley, International Nickel Co., Presented a Discussion on "Modes of Failure at High Temperature" at a Meeting in Oak Ridge. Shown are, from left: W. J. Fretague, technical chairman, Mr. Foley, and J. L. Gregg

Speaker: Francis B. Foley
International Nickel Co.

"Modes of Failure at High Temperature" was the subject discussed by Francis B. Foley, International Nickel Co., at a meeting of the Oak Ridge Chapter.

Mr. Foley stated that metals fail at elevated temperatures because they lack mechanical or chemical resistance at these temperatures.

The history of high-temperature brittleness was reviewed from as long ago as 1821, when a writer visited a Russian steelworks where bend tests were conducted at various temperatures to determine the brittle range of the metal.

With respect to elevated-tempera-

ture strength, Mr. Foley discussed the nature of grain boundaries, grain growth, diffusion, equicohesive temperature, grain size and chemical stability. He described the unusual susceptibility to deformation of metals when they reach transformation temperatures where atomic mobility may be accelerated by the transformation process.

The several types of high-temperature oxidation were covered, with particular reference to failure at elevated temperature by accelerated (catastrophic) oxidation and "green rot". The different methods of oxidation protection at these temperatures, such as metallic and ceramic coatings, were reviewed.—Reported by Charlie R. Brooks for Oak Ridge.

Presents Tool Exhibit in Washington



C. G. Schelly, Managing Director, Wilkie Foundation, Presented a Lecture and Exhibit of Ancient and Modern Tools at a Recent Meeting of the Washington Chapter. The title of his talk was "Civilization Through Tools"

Speaker: C. G. Schelly
Wilkie Foundation

The auditorium of the East Building of the National Bureau of Stand-

ards was filled to capacity to hear C. G. Schelly, managing director of the Wilkie Foundation, lecture to the Washington Chapter on the development of tools from primitive

times to the present in a talk on "Civilization Through Tools". The tool exhibit of the Wilkie Foundation, displayed through the cooperation of the DoAll Co., proved very popular with all in attendance.

Mr. Schelly literally started from sticks and stones. The sticks have not survived, but the display included stones, or eoliths, of 500,000 years ago which showed evidence of having been used, probably for breaking nuts and mashing seeds, but perhaps also for "clobbering". The lecture developed a new respect for our ancestors of 50,000 B.C., when Mr. Schelly pointed out that the basic hand tools had been invented by that time. Knives, awls, saws, drills and sickles were all known, and made in stone and wood. Newer developments changed the materials, first to copper, then bronze, and finally to steel. Designs were modified as the materials permitted. Better appreciation of our own modern times results from the realization that the use of power-driven machine tools in mass production dates back only about 150 yr., just a moment in the history of tools. What the future holds for the human race as machine tools are improved and more skillfully used is a subject for speculation for each individual member of that race.—Reported by H. E. Stauss for Washington Chapter.

Cites Future Trends in Metallurgical Research

Speaker: Walter Crafts
Electro Metallurgical Division

National Officers Night of the Toledo Chapter featured an address by Walter Crafts, national trustee and associate director of research, Electro Metallurgical Division, Union Carbide and Carbon Research Corp.

After reviewing the progress of the A.S.M. during the past year and outlining future plans of the society, Mr. Crafts spoke on "Future Trends in Metallurgical Research".

Research activities are doubling every 5 yr., and now consume about 1% of the national income. Unprogrammed work on new theories usually takes about 10 yr. before results show; tangible research 5 to 10 yr.; development work only slightly less. After a new product has been available for about 5 yr., it reaches the "acceptance stage", or about 1% of ultimate consumption. Another 5 yr. of improvements brings popular demand.

In metallurgical research, expectations are for an over-all increase of four times in the next 20 yr., with particular concentration on the newer metals. At present, there are not enough metallurgists or prospective metallurgists to meet this projected demand.—Reported by H. K. Hybarger for Toledo.



Metallurgical News and Developments

Devoted to News in the Metals Field of Special Interest to Students and Others

A Department of *Metals Review*, published by the
American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio

Illinois Tech—119 courses, ranging from industrial psychology to engineering economies, will be offered by Illinois Institute of Technology this summer. Registration will be held June 22-23 for sessions beginning June 27 and ending Aug. 19. Metallurgical, mechanical and industrial engineering are among courses offered.

Computer—An industrial computer for analyzing production of sheet materials has been announced by Industrial Nucleonics Corp. It allows instantaneous presentation of product information to permit closer control of process equipment. The computer, the AccuRay production analyzer, divides total production into five weight or thickness classifications, consisting of premium, good and reject.

New Location—Ziv Steel & Wire Co. has announced the opening of a new office and warehouse in Milwaukee, Wis., to expedite deliveries to customers in that area.

Powder Metallurgy—A 52-page booklet on "Powder Metallurgy", believed to be the most complete and authoritative work yet issued on the subject, has been published by and may be obtained from Ampex Division, Chrysler Corp., Detroit 31.

Zone Melting Apparatus—The National Bureau of Standards has developed an automatic laboratory-type zone melter which combines versatility and dependability with unusual simplicity and ease of operation. The device is being used in the Bureau's solid state physics lab to obtain extremely high-purity semiconducting materials.

Specimen Mounting Press—Buehler Ltd. has introduced a specimen-mounting press, for the preparation of metallurgical samples, which is modern in design and simple to operate. Featured are automatic temperature control, center ejection of completed specimen and the possibility of using both 1 and 1¼-in. specimen molds with the same heater and cooler.

Refractory Rammer—A light-weight, recoilless pneumatic refractory hammer designed to reduce time of applying refractories around open-

hearth tapping spouts and furnace doors has been developed by the Vibron Div. of the Burgess-Sterbentz Corp. The rammer is light, easy to handle and delivers powerful recoilless strokes. Rammer action minimizes probability of physical injury by eliminating the vibratory kick-back and refractory throwback.

Behavior of Metals—M.I.T. has announced a two-week course on "Behavior of Materials at Elevated Temperatures", to be given from July 11 through July 22. N. J. Grant, associate professor of metallurgy, will direct the program. Application blanks may be obtained from: Summer Session Office, Room 7-103, M.I.T., Cambridge 39, Mass.

New Plant—A plant for the manufacture of grinding wheels is being equipped and will be opened Jan. 1, 1956, at Santa Clara, Calif., by the Norton Co. of Worcester, Mass.

Quality Control Course—Purdue University is offering a course on "Quality Control by Statistical Methods" from June 20-28, 1955. Application should be made by writing to: Quality Control Short Course, Controllers Office, T.E.D., D.A.E., Purdue University, West Lafayette, Ind.

Thickness Gage—Blaw-Knox Co. has developed an accurate wall thickness reflectoscope which tests pipe wall thickness to within 0.005 of an in. at bends which are ordinarily difficult to check. The machine is also used to detect internal flaws in the metal by causing wave reflections to show on the scope on the machine front.

Aluminum Alloy—A new aluminum alloy, 5083, has been developed to compete with mild steel in fabrication and welding costs by Kaiser Aluminum & Chemical Corp. The alloy is designed for welded structures requiring maximum joint strength and efficiency plus light weight and corrosion resistance.

Silver Bearings—Micro Metallic Corp. has announced the availability of porous silver for use as a bearing liner. It is made from sintered wire and can carry bearing loads as high as 50 to 75% those of solid silver. Impregnation with various lubricants can readily be accomplished.

Welding Mill—Pandjiris Weldment Co. has announced that continuous seam welding tube mills, capable of welding pipe or tubing 4 to 48 in. in diam. with thicknesses of 1/16 to 1/2 in. have been added its line.

Scholarship—A four-year, tuition-paid scholarship to study mechanical or electrical engineering at Carnegie Tech is being offered by Robertshaw Research Center, Robertshaw-Fulton Controls Co. The scholarship, estimated worth \$2820 plus a \$100 cash prize for the winner, will be awarded to an outstanding high-school senior from Westmoreland County, Pa.

Water Power—A 24-page booklet which traces the development of American water power from colonial days to the emergence of the electric power era half a century ago, has been released by Allis-Chalmers Mfg. Co. It is called "Water Over the Dam".

Curing Agent—Shell Chemical Corp. has announced a new liquid curing agent, EponR Curing Agent Z, for use with epoxy resins. It combines ease of handling of liquid polyamines with the superior performance properties associated with solid polyamine curing agents.

Aluminum Crane—Kaiser Aluminum's new rolling mill on the Ohio River will have the nation's first major large-span, all-aluminum, welded mill-type cranes. Seven 105-ft. span overhead cranes have been ordered.

Lead Anodes—A round lead anode for use in chromium plating baths has been developed by Hanson-Van Winkle-Munning Co. It is designed to give better current distribution over the entire anode area, permit faster plating, better chromium coverage and use of higher current densities.

Tooling Compound—An impact-resistant plastic tooling compound suitable for drop hammer dies has been announced by Furane Plastics Inc. The compound, Epocast, based on a combination of liquid epoxy resin and a polysulfide liquid polymer, will absorb high impact stresses. Its resilience has a smoothing action on the metal that helps to eliminate wrinkles.

A.S.M. of Tomorrow

Metal Science University

What powerful and moving ideas this last important point of William H. Eisenman's great 5-Point Program for the A.S.M. of Tomorrow creates in the mind of men.

To working metals engineers and industrial management concerned with keeping abreast of swift-moving developments in metal fabrication and production, the proposed Metal Science University provides an urgently needed "proving ground for metals and metals practices".

To this University industry could bring major metallurgical problems, production, finishing, treating and other fabricating or producing difficulties. It would appeal basically to undergraduate metallurgists, graduates interested in more study and work, and anyone absorbed in the creative and practical angles of metals engineering.

Because of the scope and impact of such a University, the nation's greatest teachers, the finest research talent and high-ranking managerial experience would be attracted to its faculty.

To firmly establish itself as the moving force and spirit of the metals industries, A.S.M. could offer no finer, no more emphatic nor enduring foundation upon which to build its future.

C.S.

With the A.S.M. Metal Engineering Institute, the Metallurgical Seminars and the Metal Research Laboratory in operation, the fifth phase of my proposal follows as a natural sequence—the creation of a division of the A.S.M. to be known as the Metal Science University.

The top metal scientists, engineers and researchers will be attracted to and become a fixed part of this great assembly of metal men. Their teaching talents and instructional abilities will be fully made use of in the classrooms and laboratories of the University.

Differing from other institutions, it will offer courses in metal science only, beginning with the third-year students and continuing through the post-graduate studies. Special care will be given to the training of research workers so the graduates may help fill a void that is now developing. The graduates should also be capable of going immediately into industry and head a research department, having had training in management and research planning.

I have unfolded my view of the A.S.M. of Tomorrow. It is not a hastily conceived plan, but one towards which the Society has been moving for many years. This for-

ward looking program is no small plan, yet it is logical and can readily be carried to full fruition if only you have the will and faith to go forward.

While I am pleased to be the author of this expansion program, it is by no means a one-man operation, nor is any one man essential to its gradual accomplishment. There are hundreds of live, energetic and capable individuals who recognize that the A.S.M. should not rest on its reputation, however good it is, but must look forward and advance forward, who can easily take the formula presented here and, with the assistance of all A.S.M. members—the world's largest group of metal scientists and engineers—reach the highest peak of usefulness and service to the metal industry.

If I have expressed my thoughts clearly, you have recognized how this Metal Science Center has grown and expanded in a logical progression—each activity an advance on the frontier of increased educational activities; each one a new service for a great primary industry.

You have already visioned with me the extensive acreage necessary to comfortably accommodate and house the extensive buildings which this progressive expansion of the society will require.

You have recognized, I am sure, that as the present A.S.M. has been successful in giving extensive service to its members at a minimum cost and has, at the same time, created a firm financial structure. The A.S.M. of Tomorrow, as I have outlined it, will continue as a successful, self-sustaining organization, with all divisions helping one another so that in a smooth operating Society the net result can only be a continuous and increasing service by all of the divisions of the A.S.M. of Tomorrow.

Southern Metals Conference

The Program for the tenth annual Southern Metals Conference, sponsored by the six Southern Chapters, to be held at Lookout Mountain Hotel, Chattanooga, Tenn., from June 1 through 3, will consist of the following activities:

Wednesday, June 1

1:00 p.m. "Properties of Metals at Elevated Temperatures", by R. F. Miller, assistant to vice-president, research and technology, U. S. Steel Corp.

2:30 p.m. "Factors Which Determine the Performance of Weldments", by W. S. Pellini, Naval Research Laboratory.

Thursday, June 2

7:30 a.m. Breakfast for Southern Chapters, special meeting
9:30 a.m. "Production of Titanium", by Julian Glasser, Cramet, Inc.
11:00 a.m. "Fabrication and Application of Titanium", by Thomas W. Lippert, general manager, Titanium Metals Corp. of America
2:00 p.m. Tours: Combustion Engineering, Inc. (Men) Orchid Gardens (Women)

Friday, June 3

7:30 a.m. Breakfast for Southern Chapters chairmen
9:30 a.m. "Alloy Steel From Users Point of View", by Richard D. Chapman, Chrysler Corp.
11:00 a.m. "Heat Treating Atmospheres", by O. E. Cullen, chief metallurgist, Surface Combustion Corp.
2:00 p.m. Tours: Tennessee Products & Chemical Co., Ferro-Alloy Division (Men) Fashion Show (Women)
7:00 p.m. Banquet—"Men and Metals", by Earle C. Smith, chief metallurgist, Republic Steel Corp.

A complete program has been set up to entertain the women in the group and supervised activities are being provided for children.

IMPORTANT MEETINGS for June

June 2-3 — Electric Metal Makers Guild, Inc. 23rd Annual Meeting. Hotel Fort Shelby, Detroit. (A. C. Ogan, Secretary, E.M.M.G., Box 6026, Mt. Washington Station, Pittsburgh 11, Pa.)

June 7-10—American Welding Society. National Spring Meeting. Hotel Muehlebach, Kansas City, Mo. (J. G. Magrath, Secretary, A. W. S., 33 West 39th St., New York City)

June 14-16—Magnetics Exhibit. First Technical Conference and Exhibit on Magnetism. William Penn Hotel, Pittsburgh. Joint auspices of American Institute of Electrical Engineers, American Physical Society and American Institute of Mining and Metallurgical Engineers. (Richard Rimbach, Exhibit Manager, Magnetics Exhibit, 845 Ridge Ave., Pittsburgh 12, Pa.)

June 16-18—Malleable Founders' Society. Annual Meeting. The Greenbrier, White Sulphur Springs, W. Va. (L. D. Ryan, Managing Director, M.F.S., 1800 Union Commerce Bldg., Cleveland 14, Ohio)

June 20-24—American Society for Engineering Education. Annual Meeting. Pennsylvania State University, University Park, Pa. (N. W. Dougherty, President, A.S.E.E., Knoxville 16, Tenn.)

June 16-21—American Society for Testing Materials. Annual Meeting. Chalfonte-Haddon Hall, Atlantic City, N. J. (R. J. Painter, Executive Secretary, A.S.T.M., 1916 Race St., Philadelphia 3, Pa.)

Explains Behavior of Metals Under Load



From Left: Edwin Tuttle, John Holloman, Who Spoke on the "Behavior of Metals Under Load", and Wynant Brandel, Chairman, Enjoy a Bit of Relaxation Prior to the Technical Session at a Meeting Held in Indianapolis

Speaker: John H. Holloman
General Electric Research Laboratories

Members of the Indianapolis Chapter heard John H. Holloman, General Electric Research Laboratories, discuss "Behavior of Metals Under Load".

Dr. Holloman pointed out that we use metals to bear loads and to provide support, yet these metals must be soft, pliable and easy to shape. This brings up the question: How strong should these metals be? Physicists have made careful calculations as to the relative theoretical strengths of a number of metals. Iron, void of carbon, for example, has been calculated to have a theoretical strength of 2,000,000 psi., copper, 750,000 psi., and lead, 500,000 psi. These figures are no doubt startling because they have been unattainable by men in the metals industry. Are the calculations wrong, or is the metal at fault? Dr. Holloman attributes the difficulty in attaining these theoretical calculated strengths to the metal; specifically, to the defects or dislocations within the crystalline structure of the metal. If the so-called dislocations were absent, we would have a much stronger material, one that would undoubtedly attain the theoretical strengths calculated by the physicists.

Dr. Holloman stated that the dislocations, even though preventing the attainment of the theoretical strengths, are a necessity, for without them, the solidification of a casting would be an impossibility. He stated that a crystalline structure is made up of atoms in planes. When the structure is cut, split, etc., and then rejoined, the planes of atoms are imperfectly united, thereby causing the structure to be weaker than it was before the cutting or splitting operation. If atoms were added to the structure, growth would occur at the dislocation. The phenomena that occurs can be depicted as an addition of atoms in an ascending spiral growth. This growth always originates at a dislocation.

Dr. Holloman illustrated the phenomena of spiral growth with the aid of a time-lapse movie, which depicted an experiment which he had performed, wherein he placed cadmium iodide crystals in an aqueous solution. The solution was heated to dissolve the crystals and a few drops of the solution placed on a slide for microscopic observation. A movie camera, taking 2 frames per sec. was set up to record the progress of the spiral growth of the atoms. The time-lapse movies illus-

trated perfectly that spiral growth of the atoms does occur. The experiment proved that the growth originates at the dislocation and that the greater the number of dislocations, the greater the number of spiral processes. Thus, Dr. Holloman concluded, if a dislocation or defect is present, the spiral growth of the atoms will occur, and that nothing is lost, as more atoms are added to hold on to those already formed. However, these same dislocations make the crystal weak with respect to shear.

Ferrite grain size is the controlling factor regarding the propagation of the cracks within a structure. If the ferrite grain size is small, cracks cannot propagate. If the ferrite grain size is large, the cracks will propagate from one grain to another until the crack stretches across the entire surface. Thus, the smaller the ferrite grain size, the greater is the stress required for propagation.

Dr. Holloman concluded by stating that the defects or dislocations within a structure number in the vicinity of 10^{10} per cc. These defects are inescapable until someone develops a process whereby the defects can be either removed or prevented. Then, perhaps the theoretical strength of the various metals will be attained.—Reported by Robert Fesko for Indianapolis.

Tells How Metallurgist Can Aid Industry



Part of the Large Audience Which Was Present to Hear Horace C. Knerr, President of the Metlab Co., Give a Talk Entitled "How the Metallurgist Aids Industry" at a Meeting Held Recently by the Jacksonville Chapter

Speaker: Horace C. Knerr
Metlab Co.

Members of the Jacksonville Chapter heard Horace C. Knerr, president of the Metlab Co., present a talk on "How the Metallurgist Aids Industry".

Mr. Knerr called attention to the almost endless diversification of metallurgical problems facing the modern industrialist and engineer and the importance of selecting the right materials. Materials must be checked on receipt and through all processing stages. Design engineers must follow sound metallurgical principles

to avoid trouble in heat treating and in service, overcome problems of deformation and reduce weight while improving safety and endurance.

Mr. Knerr stressed the importance of modern scientific understanding and control of metallurgical factors in practically every phase of American industry. He related a number of interesting "who-done-its", unraveling the cause of mysterious failures of metal parts, many involving loss of life or danger to life and re-emphasized the importance of competent and thorough testing of all vital metal parts.—Reported by Harry Huester for Jacksonville.

Meet Your Chapter Chairman

WICHITA

ELDON E. VAN METER, sales engineer, Turco Products, Inc., is a native of Sylvan Grove, Kan., and a graduate of Fort Hays State Teachers College in Hays, Kan. His first job was as an elementary school teacher. During World War II, he became associated with Douglas Aircraft Corp. as a service engineer. He and his wife, Joyce, have one son and one daughter and he enjoys Boy Scout activities. His spare time is spent in hunting, fishing, boating and water skiing or woodworking.



E. E. Van Meter



R. E. Wiley



P. Patriarca

WASHINGTON

RICHARD E. WILEY, head, ferrous metals section, Research and Development Division, Bureau of Ships, was born in Minneapolis, Minn. He graduated from the University of Minnesota with a metallurgical engineering degree in 1926, made Sigma Xi and Tau Beta Pi while there, and was awarded a fellowship to Carnegie Institute of Technology, where he received a M.S. in metallurgical engineering in 1927.

First job was in National Tube Co.'s metallurgical department. In 1941 he joined the Bureau of Ships, where he worked in all sections, including nonferrous and high-temperature metallurgy, before coming to his present position.

Mr. Wiley is married and has three children and two grandchildren. He belongs to the American Society of Naval Engineers and has served in various capacities for his Chapter A.S.M. He claims his hobby is metallurgy, but he also enjoys gardening and growing dwarf fruit trees.

YORK

RAYMOND W. MUSSER, foreman in the heat treating department, Hamilton Watch Co., was born in Lancaster, Pa. He attended Franklin & Marshall College and took extension school courses in chemistry, working first in chemical control in the textile industry and later in quality control of metals. Ray is married and has a ten-year old son. He is the president of the Hamilton Watch Co.'s credit union and a member of Hamilton's management association. He likes to hunt and to work in electronics and photography in his spare time.



G. A. Fritzlen



R. W. Musser



V. H. Vieths, Jr.

TRI-CITY

VICTOR H. VIETHS, JR., was born in Davenport, Iowa. A high-school graduate with courses in college-level chemistry and physics, Vic taught practical metallurgy for three years at a local high school during World War II. He also worked as a sheet metal apprentice and in a machine shop doing inspection, laboratory and metallographic work. He is presently supervisory metallurgist at Rock Island Arsenal.

Vic is married and has a ten-year old daughter. His chief recreational interest is fishing, accompanied by practicing the fly-tying art, and he also likes to hunt.

OAK RIDGE

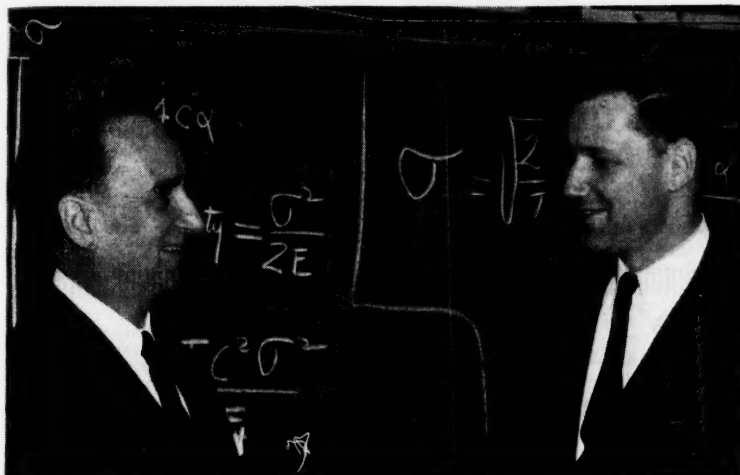
PETER PATRIARCA, metallurgist and welding engineer, Oak Ridge National Laboratory, was born in Utica, N. Y., and graduated from Rensselaer Polytechnic Institute with a M.S. in metallurgical engineering in 1950. He worked as research assistant and instructor at R.P.I. and as a materials engineer for the U. S. Air Force before starting at Oak Ridge. Pete has two children, Valerie, age 8, and Peter, age 3. He is a member of social and technical organizations and his hobbies are bowling, gardening and philately. He served with the U. S. Marine Corps from 1942 to 1945.

Cornell To Hold Seminar

The department of industrial and engineering administration of the Sibley School of Mechanical Engineering, Cornell University, is sponsoring its second annual Cornell University Industrial Engineering Seminars at Ithaca, N. Y., from June 14 through June 17, 1955.

The seminars provide an opportunity for critical study and re-appraisal of some of the major problems of manufacturing control and planning. The program will cover industrial management, manufacturing engineering, industrial marketing, small plant management, work measurement and applied industrial statistics. Speakers will be specialists from industry and the staff of the College of Engineering. Further information may be obtained from: Andrew Schultz, Jr., Cornell University, Ithaca, N. Y.

Discusses Brittle Fracture of Steel



Maurice E. Shank (Right), Assistant Professor of Mechanical Engineering, Massachusetts Institute of Technology, Gave a Talk on "Brittle Fracture of Steel" at a Meeting of the Boston Chapter, Paul Ffield (left), Bethlehem Shipbuilding Division, served as technical chairman of the meeting

Speaker: Maurice E. Shank

Massachusetts Institute of Technology

Maurice E. Shank, assistant professor of mechanical engineering, Massachusetts Institute of Technology, spoke on "Brittle Failure of Steel" at a meeting of the Boston Chapter. Dr. Shank presented examples of brittle failure of steel bridges, welded ships, gas transmission lines and storage tanks and described experimental work intended to establish the controlling factors.

Dr. Shank traced the history of brittle fractures in steel structures and showed that catastrophic failures have occurred through the years since 1879 in many riveted structures as well as units fabricated by welding. The Boston Molasses Tank failure of 1919, which caused great loss of life and extensive property damage, was cited as an example of brittle rupture of a riveted storage vessel. Costly service failures experienced by welded Liberty ships and T-2 tankers during World War II were also outlined. All of the brittle failures reported have been characterized by a cleavage fracture, sometimes containing a chevron pattern with apices pointing in the direction of origin, making it possible to trace the source of fracture. In virtually every instance, the point of origin of failure is an existing stress raiser in the form of a notch produced by a fabrication or material defect, or a geometrical discontinuity resulting from faulty design practice.

The preponderance of failures of nonship structures have occurred under conditions of static loading, and have sometimes been associated with sharp changes in temperature.

Available data indicate that steels which failed in brittle fashion possessed a low Charpy-V impact value at the failure temperature; residual and thermal stresses may be contributing factors in some cases.

Regarding metallurgical aspects, rimmed steels have been found somewhat more susceptible to brittle failure than similar steels which are deoxidized. In general, brittleness increases with increasing carbon content and decreases with manganese content. Nickel additions and the use of aluminum for deoxidation are reported to be helpful in mitigating tendencies toward brittle failure. Cold formed or worked materials may be more prone to failure than materials in a normalized or an annealed state.

A combination of factors causes brittle failure of steel structures. At present there is no readily available grade of ferritic steel which can be guaranteed against failure, and no individual test which can predict satisfactory performance of a structure. To avoid failure, it is necessary that careful attention be paid to all aspects of the job to assure adequate design, sound material and careful workmanship.

The speaker reviewed the known basic theory of brittle failure. He correlated known crystallographic and metallurgical features and explained the effect of tri-axial stressing (notch effect), strain rate and energy conditions for crack propagation.—Reported by M. B. Graham for Boston Chapter.

Reviews Advances in Heat Treatment



Howard E. Boyer (Left), Chief Metallurgist, American Bosch Division, American Bosch Arma Corp., and E. E. Staples, Executive Vice-President, Hevi Duty Electric Co., Discuss Mr. Boyer's Talk on "Application of the Newer Metallurgical Knowledge of Heat Treatment of Steel" in Milwaukee

Speaker: Howard E. Boyer

American Bosch Division

"Application of the Newer Metallurgical Knowledge of the Heat Treatment of Steel" was the title of the talk presented in Milwaukee by Howard E. Boyer, chief metallurgist, American Bosch Division, American Bosch Arma Corp.

Mr. Boyer reviewed information relative to heat treating and the

application of this new information to everyday practice. His discussion included heat treating experiences such as control of distortion, heat treatment of high speed steels, transformation of retained austenite at low temperatures with resultant dimensional changes and utilization of extreme hardness of carbides for better wear resistance.

—Reported by E. H. Schmidt for Milwaukee Chapter.

A. S. M. Review of Current Metal Literature

An Annotated Survey of Engineering,
Scientific and Industrial Journals
and Books Here and Abroad
Received During the Past Month

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A

General Metallurgical

51-A. New Process Washes Coke Oven Gas With Waste Pickle Liquor. T. E. Dixon. *Iron Age*, v. 175, Mar. 24, 1955, p. 91-93.

Simultaneous removal of ammonia, hydrogen sulphide and hydrogen cyanide from coke oven gas is now done by washing them out with the waste pickle liquor from steel plants. Flow chart. (A8)

52-A. Processing Aluminium Scrap. Herbert Capitaine. *Metal Industry*, v. 86, Feb. 25, 1955, p. 145-146. Sorting, classification; melting furnaces. Tables. 2 ref. (A8, A1)

53-A. A Dictionary of Metallurgy. A. D. Merriman and J. S. Bowden. *Metal Treatment and Drop Forging*, v. 22, Mar. 1955, p. 105-111. Defines "petzite" to "piggings back". Diagrams, tables. (To be continued.) (A10)

54-A. Toxicity of Metals. Sources of Contamination and Assessment. A. D. Merriman. *Metal Treatment and Drop Forging*, v. 22, Mar. 1955, p. 127-131, 118.

Possible sources of contamination of food by metallics and the degree of "pick-up". Harmful dosages. 16 ref. (A7)

55-A. (Book.) Minerals in World Industry. Walter H. Voskuil. 324 p. 1955. McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y. \$5.75.

A comprehensive treatment of the significance of minerals in economic productivity including ferrous and nonferrous metals, fuels, plant-food minerals, and their relation to the establishment and maintenance of a high standard of living. International political aspects of resources. (A4, B10)

56-A. (Book.) The New Atomic Energy Law—What It Means to Industry. 181 p. 1954. Atomic Industrial Forum, Inc., 260 Madison Ave., New York 16, N. Y. \$5.00.

Aspects of the law and opportunities it offers to private enterprise as interpreted by 22 authorities. (A4, A6)

The coding symbols at the end of the abstracts refer to the ASM-SLA Metallurgical Literature Classification. For details write to the American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

B

Raw Materials and Ore Preparation

67-B. Refractories in the Iron and Steel Industry. II. Alumino-Silicates: Corrosion Resistance. Helen Towers. *Iron & Steel*, v. 28, Mar. 1955, p. 101-105, 108.

Attack of refractories by various slags. Effects of permeability of linings and slag properties. 69 ref. (B19, D general)

68-B. Nickel-Cobalt Resources of Cuba. W. D. McMillan and H. W. Davis. *U. S. Bureau of Mines, Report of Investigations* 5099, Feb. 1955, 86 p.

World reserves of nickel ore; metallurgical investigations and mining of Cuban nickel-cobalt ores. Tables, maps, photographs, charts. 14 ref. (B10, Ni, Co)

69-B. Beneficiation Studies of Columbium-Tantalum-Bearing Minerals in Alluvial Black-Sand Deposits. J. E. Shelton and W. A. Stickney. *U. S. Bureau of Mines, Report of Investigations* 5105, Feb. 1955, 16 p.

Experimental study of effects of attrition scrubbing, sizing, magnetic, electrostatic and gravity separation on concentration of columbium-tantalum-bearing alluvial sands from Idaho. Tables, flow charts. (B14, Cb, Ta)

70-B. A Test for Sinter Quality. W. Kuntscher and J. Holzhey. *Henry Brucher Translation No. 3426*, 9 p. (Part from *Metallurgie und Giessereitechnik*, v. 4, no. 10, 1954, p. 435-439.) Henry Brucher, Altadena, Calif.

Previously abstracted from original. See item 29-B, 1955. (B16, Fe)

71-B. (French.) Charge-Preparation Plant for the Blast Furnaces at Mont-Saint-Martin. Aubert. *Centre de Documentation Sidérurgique, Circulaire d'Informations Techniques*, v. 12, no. 2, 1955, p. 321-343.

Crushing of ores, gathering of fines and dedusting of gas. Photographs, flowsheet, tables. (B13, D1, Fe)

72-B. Uranium Concentration With the Driessen Cone. E. O. Lilje, I. C. Edwards and H. H. McCreedy. *Canadian Mining and Metallurgical Bulletin*, v. 48, no. 515, Mar. 1955, p. 133-139; *Canadian Institute of Mining and Metallurgy, Transactions*, v. 58, 1955, p. 83-89.

Effect of equipment parameters on results. Graphs, table. (B14, U)

73-B. An Agglomeration Process for Iron Ore Concentrates. W. F. Stowasser. *Iron and Steel Engineer*, v. 32, Mar. 1955, p. 112-115; disc., p. 115.

Pilot plant process of balling the concentrates and burning these balls on a continuous horizontal grate. Photographs, diagram. (B14, Fe)

74-B. Chemistry of the Ammonia Pressure Process for Leaching Ni, Cu, and Co From Sherritt Gordon Sulphide Concentrates. F. A. Forward and V. N. Mackiw. *Journal of Metals*, v. 7; *American Institute of Mining and Metallurgical Engineers, Transactions*, v. 203, Mar. 1955, p. 457-463.

Laboratory and pilot plant studies on high-grade nickel concentrate produced from Lynn Lake ores. Graphs, diagrams. 21 ref. (B14, Ni)

75-B. Acid Pressure Leaching of Uranium Ores. F. A. Forward and J. Halpern. *Journal of Metals*, v. 7; *American Institute of Mining and Metallurgical Engineers, Transactions*, v. 203, Mar. 1955, p. 463-466.

Process for extracting uranium from ores containing sulphidic minerals, by treating an aqueous pulp of the ore with air or oxygen at elevated temperatures and pressures. Graphs. 5 ref. (B14, U)

76-B. Beneficiation Moves Forward. Norman Weiss and Stanley D. Michaelson. *Mining Engineering*, v. 7, Mar. 1955, p. 257-264.

Review of progress in 1954. Photographs. (B14)

77-B. (Chart.) Correlation Chart of Uranium Bearing Minerals. Colorado School of Mines Research Foundation, Golden, Colo. \$5.00.

Wall chart, 50" x 32", contains over 160 uranium-bearing minerals; divided into vertical chemical-radical columns, and horizontally into chemical-element bands of different colors for visual ease of correlation. Each mineral is contained in a printed box with the mineral's characteristics for definite identification. (B10, P general, S10)

C

Nonferrous Extraction and Refining

52-C. (Hungarian.) Production of High-Purity Aluminium. Endre Balazs. *Kohászati Lapok*, v. 10, no. 1, Jan. 1955, p. 17-20.

Production methods; furnace and electrode design; advantages of applications. Diagrams, table. 6 ref. (C23, Al)

53-C. (Hungarian.) Past, Present, and Future in Hungarian Nonferrous Metallurgy. Laszlo Jakoby. *Kohászati Lapok*, v. 10, no. 2, Feb. 1955, p. 91-106.

Production processes and facilities for gold, silver, platinum, copper.

lead, zinc, manganese, titanium and nonferrous scrap development. Table. (C general, Au, Ag, Pt, Cu, Pb, Mn, Ti)

54-C. (Russian.) Treatment of Al-13 Alloy by Potassium Fluorozirconate Under a Stream of Nitrogen. L. O. Sokolovskii and A. G. Kapalin. *Litseinoe Proizvodstvo*, 1955, no. 2, Feb., p. 10-12.

Method of producing high-strength aluminum-magnesium alloy. (C26, Al)

55-C. The Extraction and Purification of Scandium. R. C. Vickery. *Chemical Society, Journal*, 1955, Jan., p. 245-251.

Crude is extracted from wolframite and thortveitite and refined by ion exchange. Hydrazine-*NV*-diacetate solution is selective for scandium. Graphs, chromatograms. 20 ref. (C general, B general, Sc)

56-C. Characteristics of the Molybdenum-Depositing Arc and the Metal-Arc Melting Process. A. R. Moss. *Institution of Electrical Engineers, Proceedings*, v. 102, pt. A, no. 1, Feb. 1955, p. 45-55.

Behavior of the arc during melting in vacuum or argon atmosphere; influence of arc variables on ingot quality. Diagrams, tables, graphs, photographs. 19 ref. (C21, Mo)

57-C. The Choice and Construction of Monolithic Linings for Twin-Bath Induction Furnaces for Melting Aluminum Alloys. E. J. Thackwell. *Institution of Metals, Journal*, v. 83, Feb. 1955, p. 283-294 + 1 plate.

Development of a densely rammed, fully monolithic lining, formed and fired *in situ*. Diagrams, graph, photograph. (C21, Al)

58-C. The Use of Refractories in Low-Frequency Induction Furnaces for Melting Copper Alloys. Maurice Cook, C. L. M. Cowley and E. R. Broadfield. *Institution of Metals, Journal*, v. 83, Feb. 1955, p. 295-305 + 4 plates.

Advantages of melting in induction furnaces and features of furnace design; operations which affect the use of refractories. Diagrams, tables, photographs, graphs. 5 ref. (C21, Cu)

59-C. Aluminium Melting Furnaces. Herbert Capitaine. *Metal Industry*, v. 86, Feb. 18, 1955, p. 125-127.

Factors to be considered in selecting the size and type of furnace. Diagrams. 3 ref. (C21, Al)

60-C. (French.) Contribution to the Study of the Electrolysis of Pure Cryolite and Cryolitic Solutions of Alumina. Pierre Mergault. *Comptes rendus*, v. 240, no. 7, Feb. 14, 1955, p. 765-767.

Measures decomposition voltage of Al_2O_3 solutions in melted cryolite. Diagram. 5 ref. (C23, Al)

61-C. Refining Bismuth by Distillation and Chlorination. R. R. Rogers and R. A. Campbell. *Canadian Mining and Metallurgical Bulletin*, v. 48, no. 515, Mar. 1955, p. 121-123; disc., p. 123-126; *Canadian Institute of Mining and Metallurgy, Transactions*, v. 58, 1955, p. 71-76.

Laboratory procedures and results. Diagrams, tables, graphs. 10 ref. (C22, C4, Bi)

62-C. The Extractive Metallurgy of Zirconium by the Electrolysis of Fused Salts. III. Expanded Scale Process Development of the Electrolytic Production of Zirconium From K_2ZrF_6 . Bertram C. Raynes, Edward L. Thellmann, Morris A. Steinberg and Eugene Wainer. *Electrochemical Society, Journal*, v. 102, Mar. 1955, p. 137-144.

Pilot plant experience indicates further expansion to larger scale

operation should be feasible. Photographs, diagrams, tables, graphs. 3 ref. (C23, Zr)

63-C. Fuming of Zinc From Lead Blast Furnace Slag. R. C. Bell, G. H. Turner and E. Peters. *Journal of Metals*, v. 7; *American Institute of Mining and Metallurgical Engineers, Transactions*, v. 203, Mar. 1955, p. 472-477.

Thermodynamic study of zinc recovery reactions. Graphs, tables. 10 ref. (C21, Zn)

64-C. (English.) Fundamental Studies on Copper Smelting. II. Solubilities of Constituents of Matte in Slag. Akira Yazawa and Mitsuo Kameda. *Technology Reports, Tohoku University*, v. 19, no. 1, 1954, p. 1-22.

Determination of chemical solubilities of constituents of matte. Graphs, diagrams, tables, micrographs. 20 ref. (C21, Cu)

D

Ferrous Reduction and Refining

138-D. (Hungarian.) Quality Steel Production. Endre Szűcs. *Kohászati Lapok*, v. 10, no. 2, Feb. 1955, p. 77-88.

Hungarian and Soviet experiences in the production of unskilled, deep drawing plate material. Tables. 4 ref. (D general, CN)

139-D. (Polish.) Improvements in Continuous Casting and Direct Rolling of Steel. Z. Wusatowski. *Hutnik*, v. 21, no. 11, Nov. 1954, p. 370-375.

Status of the process in Poland, Russia and the United States. Micrographs, tables, diagrams. 36 ref. (D9, F23, ST)

140-D. (Polish.) Increasing the Coefficient of the Utilization of Open-hearth Furnace Time by Speeding up Periodic Repairs and Overhauling. Jozef Szalinski. *Hutnik*, v. 21, no. 12, Dec. 1954, p. 385-390.

Classification of repairs and methods cutting down repair time. Tables. (D2)

141-D. (Russian.) Complex Deoxidation of Steel by Silicon and Manganese. I. S. Kulikov and A. M. Samarin. *Izvestia Akademii Nauk SSSR, Otdelenie Tekhnicheskikh Nauk*, no. 10, Oct. 1954, p. 23-30.

Influence of manganese on the deoxidizing ability of silicon; solid and liquid deoxidation products at temperatures of steel production. Tables, graphs. 6 ref. (D general, ST)

142-D. (Russian.) Influence of Moisture Content of Ore on the Process of Reduction of Iron Oxides. V. T. Bragin. *Izvestia Akademii Nauk SSSR, Otdelenie Tekhnicheskikh Nauk*, no. 10, Oct. 1954, p. 31-38.

Reducibility of limonite in natural state, roasted at 550° C. and after roasting and restoration of original water content. Tables, graphs. 5 ref. (D general, CI)

143-D. Acid Electric Steelmaking Practice. C. C. Wissmann. *American Institute of Mining and Metallurgical Engineers, Electric Furnace Steel Conference, Preprint*, 1954, 13 p.

Problems in determining extent and nature of oxidation reactions. Graphs, table. 8 ref. (D5, ST)

144-D. Application of Special Elements to Electric Furnace Steels. A. J. Scheid, Jr., and W. J. Mathews. *American Institute of Mining and Metallurgical Engineers, Electric Fur-*

nace Steel Conference, Preprint, 1954, 8 p.

Effects of various additives on quality of steel. (D5, B22, ST)

145-D. Basic Electric Melting Practice for Quality Steel. A. F. Gross. *American Institute of Mining and Metallurgical Engineers, Electric Furnace Steel Conference, Preprint*, 1954, 16 p.

Effects of melting practice variables on properties of steel. Photographs, graphs, tables. (D5, ST)

146-D. The Effect of Intermittent Operation on Electric Furnace Refractories. R. P. Hill. *American Institute of Mining and Metallurgical Engineers, Electric Furnace Steel Conference, Preprint*, 1954, 1 p.

Practices for returning idle furnaces into production. (D5)

147-D. Evaluation of Performance of Electric-Arc Furnace Refractories. M. P. Fedock. *American Institute of Mining and Metallurgical Engineers, Electric Furnace Steel Conference, Preprint*, 1954, 4 p.

Effects of furnace size and melting practice on refractory consumption. Graphs. (D5, B19)

148-D. High-Alloy Steel Melting in the Basic Arc Furnace. Harold C. Templeton. *American Institute of Mining and Metallurgical Engineers, Electric Furnace Steel Conference, Preprint*, 1954, 3 p.

Melting practice for stainless steel castings. Tables. (D5, SS, CI)

149-D. Use of Reusable Insulated Low-Volume C&D Hot Tops for Yield Improvement. Joel C. Carpenter. *American Institute of Mining and Metallurgical Engineers, Electric Furnace Steel Conference, Preprint*, 1954, 4 p.

Advantages of reusable hot tops. Graph. (D9, D5, ST)

150-D. Open Hearth Operation and Control. The Use of Instrumentation. G. Reginald Bashforth. *British Steelmaker*, v. 21, Mar. 1955, p. 80-86.

Instruments for control of furnace pressure, combustion, regenerator temperature and roof temperature. Diagrams, graphs, table. 18 ref. (D2, ST)

151-D. Oxygen Steelmaking: How Canadian Plant Uses New Process. F. J. McMullin. *Iron Age*, v. 175, Mar. 31, 1955, p. 75-78.

Equipment and operating procedures; advantages of process. Characteristics of steel produced. Graphs, diagram, photograph. (D8, B22, ST)

152-D. Reducibility of Iron-Ore Lumps. A. E. El-Mehairy. *Iron and Steel Institute, Journal*, v. 179, Mar. 1955, p. 219-226.

Effects of porosity on chemical reducibility. Graphs, diagrams, tables. 30 ref. (D general)

153-D. An Improved Model for the Calculation of Heat Transfer in the O.H. Furnace. M. W. Thring and D. Smith. *Iron and Steel Institute, Journal*, v. 179, Mar. 1955, p. 227-230.

Model is used to calculate average roof temperature and thermal efficiency during melting period. Diagram, table. 6 ref. (D2)

154-D. The Supply of Scrap to Open-Hearth Furnaces. M. D. J. Brisby and W. O. Pendray. *Iron and Steel Institute, Journal*, v. 179, Mar. 1955, p. 252-260.

Causes and corrective procedures for charging delays. Graphs, tables. (D2, ST)

155-D. Charging Delays Due to Furnace Bunching. A Method of Assessment. R. Solt. *Iron and Steel Institute, Journal*, v. 179, Mar. 1955, p. 260-264.

Operational analysis of charging.

Derives method for forecasting changing demand of furnaces. Graphs, table. 1 ref. (D2, ST)

156-D. Progress in Steelmaking. **O₂ Blast Enrichment Shortens Blowing Time.** *Steel*, v. 136, Mar. 21, 1955, p. 124, 127, 130.

Development and uses of oxygen in steelmaking. (D3, ST)

157-D. Dephosphorization in a Side-Blown Basic Converter. R. C. Buehl and M. B. Royer. *U. S. Bureau of Mines, Report of Investigations* 5102, Feb. 1955, 20 p.

Modification of side-blown basic-lined converter and operating procedures for dephosphorizing a high-manganese slag. Photographs, diagrams, tables. 8 ref. (D3, D2)

158-D. Oxygen Converter Experiences. F. H. Baer. *Western Machinery and Steel World*, v. 46, Mar. 1955, p. 100-103.

Results of 18 months experience at an Austrian steel plant. Photographs. (D3, ST)

159-D. The Production of Ferromanganese. V. P. Elyutin, Yu. A. Pavlov and B. E. Levin. *Henry Brucher Translation No. 3436*, 27 p. (Part from Book "The Production of Ferroalloys", Chap. V. 1951. Metallurgizdat, Moscow, Russia.) Henry Brucher, Altadena, Calif.

Survey of production methods for various grades; other products. Tables, graphs. 3 ref. (D general, Fe, Mn)

160-D. (French.) Tests With Cowper Apparatuses. D. Sanna. *Centre de Documentation Sidérurgique, Circulaire d'Informations Techniques*, v. 12, no. 2, 1955, p. 345-382.

Lengthy study of tests to study accumulation of heat, charge losses and heat transfer in blast furnace stoves. Tables, graphs. (D1)

161-D. (French.) Report of Heat-Accumulation Tests Conducted at the Louvroil Factory on a D. Petit Cowper. Moutot. *Centre de Documentation Sidérurgique, Circulaire d'Informations Techniques*, v. 12, no. 2, 1955, p. 383-401.

Effects of various operating conditions. Diagrams, tables, graphs. (D1)

162-D. (French.) Small Converter for the Steel Foundry. Marcel Guédra. *Métallurgie et la construction mécanique*, v. 87, no. 2, Feb. 1955, p. 103-104.

Economic advantages of the side-blown bessemer over the electric furnace. Graph. (D3, D5, CI)

163-D. (French.) Results of a Year of Research on the Low-Shaft Blast Furnace. International Steering Committee. *Revue universelle des mines*, v. 11, ser. 9, no. 2, Feb. 1955, p. 45-67.

Tests and discussion of results obtained. Diagrams, photographs, tables, graphs. 6 ref. (D1)

164-D. (French.) Desulfurization in a Basic Converter. J. Wampach and A. Decker. *Revue universelle des mines*, v. 11, ser. 9, no. 2, Feb. 1955, p. 68-75.

Screening of lime for use in converters; factors influencing desulfurization. Tables, graphs. 7 ref. (D3, Fe, Mn)

165-D. Economic Aspects of the Oxygen Converter. W. C. Rueckel and J. W. Irvin. *Iron and Steel Engineer*, v. 32, Mar. 1955, p. 61-63; disc., p. 64-65.

Comparison of costs of oxygen converter with an openhearth furnace operation indicates a net saving through the use of the converter. Photograph, tables. 4 ref. (D3, D2)

166-D. The Venturi Washer for Blast Furnace Gas. J. E. Eberhardt and H. S. Graham. *Iron and Steel Engineer*, Mar. 1955, v. 32, p. 66-71; disc., p. 71-72.

New venturi-type blast furnace

gas washer promises efficient cleaning at water consumptions as low as 5-gal. per 1000 cu. ft. of gas. Diagrams, photographs, graphs. (D1)

167-D. Ferro-Manganese Additions in Open Hearth Steelmaking. Rudolph Tietig, Jr. *Iron and Steel Engineer*, v. 32, Mar. 1955, p. 82-86; disc., p. 86-89.

Controlled addition of manganese at proper point in ladle accomplished by mechanical feeder should give a minimum saving in manganese cost of \$0.15 per ingot ton, and for some grades of steel, reductions in cost up to \$0.30 a ton. Tables, diagram, photograph. (D2, ST)

168-D. Maintenance of Electric Furnace Bottoms as Practiced in Bethlehem Plant. H. C. Bigge. *Journal of Metals*, v. 7, Mar. 1955, p. 453-456.

Installation and hole-patching procedures for 96% magnesia rammed bottom. Photographs, diagram, tables. 5 ref. (D5, A5)

169-D. Preparation and Arc Melting of High Purity Iron. G. W. P. Rengstorff and H. B. Goodwin. *Journal of Metals*, v. 7; *American Institute of Mining and Metallurgical Engineers, Transactions*, v. 203, Mar. 1955, p. 467-471.

Method for purifying iron in batches of 150 lb. or more. Oxygen, carbon, nitrogen and sulphur are removed from flakes of electrolytic iron by treatment in wet and then dry hydrogen. A special consumable-electrode arc furnace is used to remove hydrogen and to melt the flakes into ingots. Diagrams, tables. 7 ref. (D5, Fe)

170-D. Oxygen Steelmaking Arrives. Thomas F. Hruby. *Steel*, v. 136, Apr. 4, 1955, p. 80-83.

Oxygen steelmaking processes and experiences at two steel plants. Reactions in the steelmaking vessel. Future outlook for oxygen steelmaking. Photographs. (D8)

171-D. (Book.) Third Report of the Ingot Moulds Sub-Committee. Iron and Steel Institute Special Report No. 52. 72 p. 1955. The Iron and Steel Institute, 4 Grosvenor Gardens, London, S. W. 1, England. £1:5:0.

Survey and analysis of service conditions in British steelmaking ingot practice; effects of mold composition; properties of mold metals; and design of ingot molds. (D9)

E

Foundry

150-E. (Czech.) Industrial Production of Spheroidal Cast Iron at High Pressure. Vlastislav Otahal. *Stěvarensťvi*, v. 3, no. 1, Jan. 1955, p. 2-6.

Use of 4.5 to 5.5 atmospheres reduces amount of magnesium required for inoculation. Graphs, photographs, diagram. 13 ref. (E25, CI)

151-E. (Czech.) Mechanization of Permanent Mold Casting of Gray Iron. Karel Mlcoch. *Stěvarensťvi*, v. 3, no. 1, Jan. 1955, p. 6-9.

Automatic rotating machine reduces costs by as much as 25%. Photographs. 6 ref. (E12, CI)

152-E. (Czech.) Hydrometer Method Determines Clay Content of Foundry Sands. Jiri Ornst. *Stěvarensťvi*, v. 3, no. 1; *Prace Československého Vyzkumu Stěvarenského*, v. 2, no. 14, Jan. 1955, p. 101-106.

Simple method evaluates sand

mixtures in about 15 min. but does not replace standard method for precise determinations. Graphs, tables. 17 ref. (E18)

153-E. (Hungarian.) Metal Penetration Into the Material of the Mold. Zoltan Nagy. *Ontöde*, v. 6, no. 1, Jan. 1955, p. 7-12.

Investigations to eliminate defects caused by the sand burning on the casting. Diagrams, graphs, tables. 8 ref. (E19)

154-E. (Hungarian.) Causes of Defects in Nonferrous Metal Castings. Laszlo Jakoby. *Ontöde*, v. 6, no. 2, Feb. 1955, p. 32-39.

Suggestions for overcoming defects resulting from casting procedures or core preparation. Diagrams, tables. (E25, Al, Zn)

155-E. (Russian.) Hydrodynamic Theory of Horizontal Centrifugal Casting. B. F. Vilium. *Izvestia Akademii Nauk SSSR, Otdelenie Tekhnicheskikh Nauk*, 1954, no. 10, Oct., p. 39-46.

Mathematical solution of flow of molten metal during centrifugal casting. Diagrams, table. 2 ref. (E14)

156-E. (Russian.) Casting of Complex Machine Parts Using Magnesium Cast Iron. V. I. Soldatenko, M. I. Rotenberg and V. M. Iangunav. *Liteneoe Proizvodstvo*, 1955, no. 2, Feb., p. 5-6.

Method of alloying and casting. Table, micrographs. (E11, CI)

157-E. (Russian.) Peculiarities in Production of Magnesium Cast Iron. V. A. Zakharov. *Liteneoe Proizvodstvo*, 1955, no. 2, Feb., p. 14-16.

Experimental investigation of the influence of magnesium on carbon content, form of residual graphite and general metallographic structure. Tables, micrographs. 2 ref. (E25, CI)

158-E. Use of Basic Ladle Linings in the Foundry. K. T. Appar. *American Institute of Mining and Metallurgical Engineers, Electric Furnace Steel Conference, Preprint*, 1954, 1 p.

Lining practice required for Hadfield steel. (E10, CI)

159-E. Solidification Sequences and Their Significance. I. C. H. Hughes. *British Cast Iron Research Association. Journal of Research and Development*, v. 5, Feb. 1955, p. 518-536 + 4 plates.

Shrinkage characteristics of flake graphite and nodular graphite irons. Correlation of shrinkage defects. Diagrams, graphs, micrograph, photographs. 11 ref. (E25, CI)

160-E. The Solidification of Castings in Relation to Their Soundness. Microscopic and Thermal Analyses of Solidification in 2-In. Grey Iron Bars. J. H. Gittus and I. C. H. Hughes. *British Cast Iron Research Association. Journal of Research and Development*, v. 5, Feb. 1955, p. 537-554 + 10 plates.

Modes of solidification of low-phosphorus flake graphite, high-phosphorus flake graphite, and nodular graphite cast irons of sand-cast bars quenched at various times during solidification were studied. Table, graphs, micrographs, photographs. (E25, CI)

161-E. The Effect of Dead Clay on the Properties of Clay-Bonded Sand. W. B. Parkes and A. G. Sealey. *British Cast Iron Research Association. Journal of Research and Development*, v. 5, Feb. 1955, p. 555-562.

Tests to determine nonplastic clay by means of moisture content. Methods of controlling dead clay and neutralizing its effect. Graphs. 1 ref. (E18)

162-E. The Collection of Cupola Dust. F. M. Shaw. *British Cast Iron Research Association. Journal of Research and Development*, v. 5, Feb. 1955, p. 563-592.

Characteristics of cupola dust and dust collectors. Tables, diagrams, graphs. 32 ref. (E10, A8)

163-E. Battery of Timers Controls Cycle Sequence. Otto W. Winter and Frank B. Hall. *Electrical Manufacturing*, v. 55, Mar. 1955, p. 110-117.

Synchronous timers permit automation of shell molding machine. Photographs, diagrams, circuit diagrams. (E16)

164-E. Melt-Quality Tests for Copper-Base Alloys. A. R. French. *Foundry Trade Journal*, v. 98, Mar. 10, 1955, p. 253-257; Mar. 17, 1955, p. 281-293.

Types of prepouring tests; evaluation of test results from standpoint of service properties desired and metallurgical characteristics. Photographs, micrographs, diagrams, tables. 16 ref. (E25, Cu)

165-E. Some Uses of Silica Sols in Precision Investment Casting. D. J. Cloherty and H. G. Emblem. *Industrial Chemist and Chemical Manufacturer*, v. 31, Mar. 1955, p. 111-114.

Seeks replacements for the flameable ethyl silicate binder. Tables, diagram. 14 ref. (E15)

166-E. Shell Molding for Short-Run Production. Frank K. Shallenberger. *Product Engineering*, v. 26, Mar. 1955, p. 175-179.

Advantages and applicability of the process; 12 specific guides to minimum piece cost. Photographs, table. (E16)

167-E. Shell Molding. Curtis L. Graversen. *Western Machinery and Steel World*, v. 46, Mar. 1955, p. 84-87.

Basic principles; advantages and disadvantages; typical applications; future possibilities. Photographs. (E16)

168-E. Cupola With Oxygen-Enriched Blast. V. N. Filippov. *Henry Brucher Translation No. 3429*, 3 p. (From *Litinoe Proizvodstvo*, 1952, no. 5, p. 27.) Henry Brucher, Altadena, Calif.

Procedures for treating cupola iron with oxygen; effects on mechanical properties of cast iron. Diagrams. (E10, Q general, CI)

169-E. (French.) High Strength Cast Irons Without Special Elements. I. Technical Factors of the Problem. J. Pascal. *Métallurgie et la construction mécanique*, v. 87, no. 2, Feb. 1955, p. 95-97, 99, 101.

Foundry techniques for making high-strength castings. (To be continued.) (E general, Q23, CI)

170-E. (German.) The Layering Process, a Means for Determining the Casting Method and Casting Rate for Steel. Sten Forslund. *Giesserei*, v. 42, no. 4, Feb. 17, 1955, p. 73-81.

Processes of movement at the metal front; processes during cold casting. Details and advantages of the layering process. Photographs, diagrams, graphs. (E11, CI)

171-E. (German.) Chemical Attacks of the Melting and Fluxing Agents as Well as of the Metals on the Graphite Crucible. Elisabeth Lotze. *Giesserei*, v. 42, no. 4, Feb. 17, 1955, p. 85-88.

Observations on various attacks; examples of crucible defects; practical suggestions. Photographs. (E10)

172-E. (German.) Effect of Silicon, Copper, Zinc, and Magnesium on Cracking, Flowability, and Strength Properties of Cast Alloy G AlSiCu. Eduard Bertram, Wilhelm Patterson and Rudolf Kümmerle. *Giesserei*, v. 42, no. 5, Mar. 3, 1955, p. 97-102.

Casting characteristics and mechanical properties; effects of foundry variables. Graphs, table, diagrams, photograph. 4 ref. (E general, Q23, Al)

173-E. (German.) Melting With Inert Coke. Wilhelm Heinrichs. *Giesserei*, v. 42, no. 5, Mar. 3, 1955, p. 102-106.

Advantages of melting with high-carbon coke. Tables, graphs, micrographs. 3 ref. (E10, CI)

174-E. (German.) Segregation in Heavy-Metal Casting. Rudolf Rovens-trunk. *Giesserei*, v. 42, no. 5, Mar. 3, 1955, p. 137-146.

Causes and prevention of segregation in lead alloy castings. Diagrams. (E25, Pb)

175-E. (German.) Technical Testing of Pressure Castings. Gustav Lieby. *Zeitschrift für Metallkunde*, v. 46, no. 2, Feb. 1955, p. 137-146.

Quality control; use of various testing procedures. Diagrams, photographs. 10 ref. (E13)

176-E. (Swedish.) Casting Defects and Their Causes. VII. Mold Wall Analysis. *Gjuteriet*, v. 45, no. 2, Feb. 1955, p. 17-21.

Properties of mold walls and factors controlling them. Tables. 13 ref. (E25)

177-E. (Swedish.) Dephosphorization of Cast Iron by the Addition of Magnesium, Calcium, and Cerium Under Reducing Conditions. G. Ostberg. *Gjuteriet*, v. 45, no. 2, Feb. 1955, p. 24-25.

Theoretical and practical aspects of the process which currently seems to be practical for dephosphorization of ferro-alloys. Table. 8 ref. (E10, CI)

178-E. Steel Penetration. R. C. Emmons and Jack Bach. *Foundry*, v. 83, Apr. 1955, p. 108-116.

Causes; mechanism of action; corrective measures. Micrographs, photographs, graphs, tables, diagrams. 2 ref. (E25, CI)

179-E. (Czech.) Production of Spheroidal Cast Iron at the V. M. Molotov Works in Trinec. Milos Stareck. *Stěvarensťvi*, v. 3, no. 2, Feb. 1955, p. 36-41.

Controlled cast iron melting, for magnesium inoculation, results in the production of the heaviest spheroidal iron casting possessing good structure and mechanical properties. Micrographs, tables, diagram, photograph. (E25, CI)

180-E. (Czech.) Centrifugal Casting of Tubular Steel Castings. Frantisek Wiesner. *Stěvarensťvi*, v. 3, no. 2, Feb. 1955, p. 44-47.

Several methods and theories and various types of centrifugal machines, with horizontal or vertical rotational axis, described. Diagrams, table, graph. 4 ref. (E14, CI)

F

Primary Mechanical Working

76-F. (Polish.) Materials Standards for Forging. Wieslaw Wroblewski. *Hutnik*, v. 21, no. 12, Dec. 1954, p. 395-399.

Principles and equations for efficient utilization of rods and billets used in forging and stamping. Table. 5 ref. (F22)

77-F. High Speed Heating of Steel for Plastic Deformation. E. G. de Coriolis. *Blast Furnace and Steel Plant*, v. 43, Mar. 1955, p. 320-324, 351.

Factors influencing the maximum rate of heating billets in gas-fired

furnaces. Graphs, tables. 7 ref. (F1, ST)

78-F. Stretch-Flattening of Large Sheets and Plates. Hydraulic Machine With 800-Ton Pull. *Engineering*, v. 179, Mar. 4, 1955, p. 282-284.

Equipment and operation procedures. Diagrams, photographs. (F29)

79-F. The Production of Light-Alloy Drop-Forgings, Their Heat-Treatment, Inspection, and Testing. W. T. Edmunds and R. C. Lloyd. *Institute of Metals, Journal*, v. 83, Feb. 1955, p. 247-261 + 2 plates.

Comparison of different types of aluminum alloy forging stock; effects of heat treatment; methods of inspection and types of defects; relationship between macrostructure, microstructure, and mechanical properties of forgings. Tables, graphs, diagrams, photographs, micrographs. 7 ref. (F22, J general, S general, Al)

80-F. Hot Rolling. A Study of Draught, Spread and Elongation. Z. Wusatowski. *Iron & Steel*, v. 28, Mar. 1955, p. 89-94.

Coefficient of spread and roll pass design calculations. Graphs, tables. (F23)

81-F. The Rolling of Metals and Alloys. IV. Resistance to Deformation and Other Factors Which Determine the Magnitude of the Rolling Load. E. C. Larke. *Sheet Metal Industries*, v. 32, no. 335, Mar. 1955, p. 217-222, 224.

Effects of roll surface condition and initial strip thickness. Diagrams, micrographs, graphs. 12 ref. (To be continued.) (F23)

82-F. The State of Lubrication in Wire Drawing Operations. R. Tourret. *Wire and Wire Products*, v. 30, Mar. 1955, p. 299-303, 347.

Tests of wiredrawing lubricants to determine the effects of pressures and temperatures on dies and on the aluminum, brass, copper and steel wire being drawn. Graphs, diagram, photograph, tables. 26 ref. (F28, CN, Cu)

83-F. Graphic Analysis of the Relation Between the Wire and Capstan Speeds on Multiple Wire-Drawing Machines. J. A. Giaro. *Wire and Wire Products*, v. 30, Mar. 1955, p. 305-312.

Graphic method for determining relative speeds of drawing capstans in terms of die diameters. Chart, diagrams. 11 ref. (F28)

84-F. (French.) Comparative Examination of Different Systems of Hot Deformation. Giovanni Dallapiccola. *Métallurgie et la construction mécanique*, v. 87, no. 2, Feb. 1955, p. 129, 131, 133.

Hand, hammer, press and automatic forging. Drawings, micrographs, table. (F22)

85-F. (German.) Flame Straightening. Richard Pfeiffer. *Schweisstechnik*, v. 8, no. 12, Dec. 1954, p. 133-141.

Economic considerations; applications. Photographs. 4 ref. (F29)

G

Secondary Mechanical Working

82-G. Cope Talks on Draw Dies. XXV. How to Make Shells With Ribs, Bosses and Projections. Stanley R. Cope. *American Machinist*, v. 99, Mar. 14, 1955, p. 145-148.

Ways to cause metal to flow properly in a series of operations. Diagrams. (To be continued.) (G4)

83-G. **Machining and Machinability.** Francis W. Boulger. *Canadian Metals*, v. 18, Mar. 1955, p. 40-41.

Machinability depends on inherent properties of the material and on machining operation. Most important properties affecting machinability are frictional behavior and strength of the metal in the actual cutting direction. Graphs, diagram, photograph. (To e continued). (G17)

84-G. **Electronic Tracer Control of Machine Tools.** J. A. Stokes. *Engineer*, v. 199, Feb. 25, 1955, p. 268-270.

Several forms of tracer control equipment applicable to a wide range of machine tools. Photographs, diagrams. (G17)

85-G. **Drawing and Forming Chromium-Nickel Stainless Steels.** W. E. McFee. *Finish*, v. 12, Apr. 1955, p. 27-30.

Die practice and lubricants. Photographs, table. (G4, SS)

86-G. **Metal Machining. II. Cutting Forces and Cutting Conditions.** W. E. Alfred Carter. *Machinery Lloyd (Overseas Ed.)* v. 27, Feb. 26, 1955, p. 69, 71-74.

Stresses in tools; action of cutting fluids. Diagrams, photograph. (G17, G21)

87-G. **The Use of Ethoxylated Resins in Modern Tool Manufacture.** K. Meyerhans. *Sheet Metal Industries*, v. 32, no. 335, Mar. 1955, p. 165-172; disc., p. 172-175.

Properties of resins, uses in manufacture of blanking, piercing and forming dies. Tables, diagrams. (G2)

88-G. (Italian.) **Grinding and Buffing of Semiworked Metal Before Fabrication and Finishing of the Piece.** *Industria Meccanica*, v. 7, no. 1, Jan. 1955, p. 29-32.

Suggested techniques as aids for above operations. Table. (G18, L10)

89-G. (Polish.) **Causes of Lamination of Brass Used in Deep Drawing.** S. Balicki and L. Gablankowski. *Prace Instytutow Ministerstwa Hutnictwa*, 1954, no. 6, p. 315-320.

The residual beta-phase and the hydrogen entering at time of melting and pouring are responsible for the defects, and both are eliminated by heating at 800° C. before plastic working. Micrographs, tables, graph, diagram, photographs. 8 ref. (G4, Cu)

90-G. **Short Run Press-Formed Parts.** Malcolm W. Riley. *Materials & Methods*, v. 41, Mar. 1955, p. 121-136.

Forming methods; advantages and limitations; design considerations. Photograph, diagrams, tables. (G1)

H

Powder Metallurgy

105-H. **Resistance Sintering of Powder Compacts.** *Metal Industry*, v. 86, Mar. 4, 1955, p. 176.

Equipment and operating procedures. 1 ref. (H15)

106-H. **Now: High Strength Alloy Steel Powder Metal Parts.** *Product Engineering*, v. 26, Mar. 1955, p. 133-138.

Production of products from pre-alloyed steel powders. Properties and design factors. Photographs, micrographs, tables, graphs. (H12, H general, AY)

107-H. **Improved Tungsten Carbide-Cobalt Compacts by Electric-Resistance Sintering.** Perry G. Cotter, J.

A. Kohn and R. A. Potter. *U. S. Bureau of Mines, Report of Investigations* 5100, Jan. 1955, 19 p.

Effects of high temperatures and pressures on mechanical properties. Photographs, diagram, tables, graphs. (H15, C-n)

108-H. **Hot Pressing Technique for Metal Carbides and a Semiautomatic Hot Press.** J. Rietveld. *Henry Brucher Translation No. 3356*, 7 p. (From *Metall*, v. 6, nos. 3-4, 1952, p. 81-82.) Henry Brucher, Altadena, Calif.

Previously abstracted from original. See item 40-H, 1953. (H14, C-n)

J

Heat Treatment

84-J. (Polish.) **Patenting of Steel Wire Heated Directly by Electric Current.** Julian Lasota. *Hutnik*, v. 21, no. 11, Nov. 1954, p. 352-356.

Laboratory equipment and advantages of process. Tables, graphs, diagram, micrographs. 4 ref. (J25, ST)

85-J. (Russian.) **Isothermal Heat Treatment of Nodular Cast Iron.** T. G. Demidova and M. N. Kuniavskii. *Litmoos Proizvodstvo*, 1955, no. 2, Feb., p. 20-22.

Isothermal decomposition of austenite; microstructure and microhardness; wear resistance. Graphs, micrographs, diagram. 6 ref. (J26, M27, CI)

86-J. **Electrical Control for Continuous Annealing Line.** P. A. Traviano. *Blast Furnace and Steel Plant*, v. 43, Mar. 1955, p. 305-309, 314.

Details of equipment for handling up to 30 tons per hr. of light-gage steel strip. Photographs, diagrams. (J23, ST)

87-J. **Heat-Treatment and Finishing Operations in the Production of Copper and Aluminium Rod and Wire.** H. J. Miller. *Institute of Metals, Journal*, v. 83, Feb. 1955, p. 221-232 + 1 plate.

Annealing and heat treatment operations; factors determining surface quality of wires. Table, graphs, micrograph, photographs. 17 ref. (J23, Al, Cu)

88-J. **Short Cycle Anneal Restores Ductility in Cold Extrusions.** C. A. Turner, Jr. *Iron Age*, v. 175, Mar. 10, 1955, p. 96-99.

Equipment and operating procedures for fast and selective annealing of steel rocket heads. Photographs, micrographs, diagram. (J23, Q23, CN)

89-J. **Mechanized Austempering Line Shortens Heat-Treating Time.** H. K. Jamesson. *Iron Age*, v. 175, Mar. 24, 1955, p. 100-101.

Austempering of wrenches in a new line using electric salt bath furnaces and mechanized conveyors has reduced processing time from 10 to 1½ hr. Treatment is in three steps—autenitize, quench and draw. Micrograph, photographs. (J26, CN)

90-J. (French.) **Quantitative Study of the Kinetics of Cooling Nickel Specimens During High Speed Quenching in Different Liquids.** Roland Bigot and René Faivre. *Comptes rendus*, v. 240, no. 7, Feb. 14, 1955, p. 774-775.

Cooling rates in mercury, petroleum, distilled water and brine. Cooling curves are plotted. Graphs. 8 ref. (J26, Ni)

91-J. (German.) **Hardening of Aluminium-Magnesium Alloys.** Otto Dahl and

Klaus Detert. *Zeitschrift für Metallkunde*, v. 46, no. 2, Feb. 1955, p. 94-99.

Behavior during annealing; structure, hardness, tensile strength and elongation; changes of thermo-electric power and electrical resistance for interpreting precipitation behavior. Micrographs, graphs, tables. 15 ref. (J23, J27, M27, P15, Q29, Al, Mg)

92-J. (Japanese.) **Hardening of Spring Steel.** Shigeo Owaku, Ryozo Isomura, Seinoshin Morikawa and Hatsukichi Sato. *Journal of Railway Engineering Research (Japan)*, v. 12, no. 1, Jan. 10, 1955, p. 18-21.

Comparison of properties of several Japanese spring alloys. Diagrams, micrographs, graphs. (J26, SG-b)

K

Joining

126-K. (Russian.) **Investigation of the Process of Melting Metal During Arc Welding Using Thick Coated Electrodes With High Currents.** A. A. Erokhin. *Svarochnoe Proizvodstvo*, 1955, no. 2, Feb., p. 1-3.

Compares operation under normal conditions and under conditions where rate of welding is up to 60 cm. per min. with a current of 300 amp. Diagrams, graphs. 4 ref. (K1)

127-K. (Russian.) **Investigation of the Metallurgy and Technology of Thermite Welding of Steel 30L.** M. M. Timofeev. *Svarochnoe Proizvodstvo*, 1955, no. 1, Jan., p. 5-8.

Microstructure and mechanical properties of welded cast steel as a function of the aluminum-oxygen ratio in the thermite. Photographs, micrographs, graphs, diagram, table. 4 ref. (K4, M27, Q general, CI)

128-K. (Russian.) **Melting of Electrode Wire During Automatic Argon-Arc Welding.** A. V. Petrov. *Svarochnoe Proizvodstvo*, 1955, no. 2, Feb., p. 4-7.

Relations between applied current, size of electrode and physical properties of the wire on melting. Diagrams, graphs. 3 ref. (K1)

129-K. (Russian.) **Stability of the Microstructure and Properties of Butt Joints of Austenitic Steel With Pearlite Steel.** A. S. Gel'man and V. S. Popov. *Svarochnoe Proizvodstvo*, 1955, no. 2, Feb., p. 7-10.

Influence of composition and heat treatment of 26 austenitic and pearlitic high-alloy steels to determine optimum conditions for joining. Tables, diagrams, micrographs. (K general, Q general, M27, AY)

130-K. (Russian.) **Automatic and Semi-Automatic Welding of Cast Steel Under the Protection of Carbon Dioxide Atmosphere.** V. N. Suslov. *Svarochnoe Proizvodstvo*, 1955, no. 1, Jan., p. 14-17.

Repair of casting defects; properties of weld metal; control of cracking after welding. Graphs, tables, photographs. 2 ref. (K1, CI)

131-K. (Russian.) **Semi-Automatic Equipment PEGSh-1 for Welding Defects in Steel Castings by a Melting Electrode in the Protective Atmosphere of Carbon Dioxide.** L. V. Golub. *Svarochnoe Proizvodstvo*, 1955, no. 1, Jan., p. 17-19.

Description of apparatus, its operation and results in practice. Photograph, table, circuit diagram, diagram. (K1, CI)

132-K. Adhesives for Metal Aircraft Structures. K. S. Meakin. *Adhesives & Resins*, v. 3, Jan. 1955, p. 4-7. Successful application of Redux bonding method. Tables. (K12)

133-K. Spot Welding of Hardenable Steels. A Review of Information Published up to June 1954. H. E. Dixon. *British Welding Journal*, v. 2, Mar. 1955, p. 121-133.

Effect of sheet thickness and composition; recommended welding conditions; appraisal of testing methods. Graphs, tables, diagrams. 24 ref. (K3, ST)

134-K. Arc Welding Costs. A. G. Thompson. *British Welding Journal*, v. 2, Mar. 1955, p. 134-141.

Economic aspects of welding procedures and costs of labor, electrodes and electric power. Tables, diagram. 21 ref. (K1)

135-K. A Single Cycle Timer for Small Spot Welders. G. O. Crowther and L. H. Light. *Electronic Engineering*, v. 27, Mar. 1955, p. 111-114.

Use of timer results in improved welding quality. Welding time is reduced to as short a period as is consistent with the peak power handling capacity of the welding machine. Diagrams. 2 ref. (K3)

136-K. Welding Titanium Without Filler Rod Improves Joint Efficiency. A. V. Levy and Robert Wickham. *Iron Age*, v. 175, Mar. 17, 1955, p. 99-102.

Materials and methods for inert-gas shielded tungsten-arc welding by manual methods. Photographs, tables. (K1, Ti)

137-K. Spot Welds Work Well in Titanium. M. L. Begeman and Frank W. McFee, Jr. *Machinist (London)*, v. 99, Feb. 25, 1955, p. 329-331.

Research indicates method is particularly suited for commercially pure titanium. Graphs, photographs, tables. 16 ref. (K3, Ti)

138-K. Adhesive Bonding Properties of Various Metals as Affected by Chemical and Anodizing Treatments of the Surfaces. I. Additional Tests on Anodized Aluminum and on Zinc-Chromate-Primed Magnesium. H. W. Eickner. U. S. Department of Agriculture, Forest Products Laboratory, Report No. 1842-A, Feb. 1955, 9 p.

Good joints obtained on surfaces which were not seal treated. Tables. (K12, Al, Mg)

139-K. Significance of Recent Resistance Welding Research. II. J. E. Roberts. *Welding and Metal Fabrication*, v. 23, Mar. 1955, p. 97-102.

Resistance bolt welding; spot welding aluminum alloys; properties of aluminum alloy welds. Tables, diagrams, graphs, photographs. 19 ref. (K3, Al)

140-K. Weld Metal Dilution Effects in the Metal-Arc Welding of Al-Mg-Si Alloys. W. I. Pumphrey. *British Welding Journal*, v. 2, Mar. 1955, p. 93-97.

Extent to which filler metal is diluted by parent metal when using electrodes based on Al-5% Si and Al-10% Si alloy core wires. Micrographs, graphs, table. 4 ref. (K1, Al)

141-K. How to Weld Pot Metal. Harry Kerwin and Keith Kerwin. *Welding Engineer*, v. 40, Apr. 1955, p. 25-27.

Flame welding procedures. Photographs. (K2, Zn)

142-K. Low-Heat Method of Welding Cast Iron. Arthur L. Phillips. *Welding Engineer*, v. 40, Apr. 1955, p. 30-33.

Torch and arc-welding methods. Photographs. (K1, K2, CI)

143-K. Fusion Welding Titanium Without Filler Metal. Alan V. Levy and Robert Wickham. *Welding Engineer*, v. 40, Apr. 1955, p. 38-41.

Gas-shielded arc welding equipment and methods. Photographs, tables. (K1, Ti)

144-K. Brazing Titanium to Titanium and to Mild and Stainless Steels. W. J. Lewis, P. S. Rieppel and C. B. Voldrich. Wright Air Development Center Materials Laboratory, WADC Technical Report 52-313, pt. 1, Nov. 1952, 34 p. U. S. Department of Commerce, Office of Technical Services, PB 111244.

Procedures and alloys suitable for brazing titanium; most satisfactory alloys for furnace brazing were silver and silver-base alloys; good joints also made by torch brazing. Photographs, tables, micrographs, diagram. (K8, Ti, SS)

Cleaning, Coating and Finishing

253-L. (Russian.) Influence of Structure and Composition of Cast Iron on the Quality of Enamel Coating. I. N. Iukalov. *Liteinoe Proizvodstvo*, 1955, no. 2, Feb., p. 1-5.

Influence of silicon, manganese, sulfur, phosphorus, chromium and nickel content; method of preparation of cast iron for enameling. Tables, micrographs, diagram. 15 ref. (L27, CI)

254-L. (Russian.) Electrodes for Wear Resistant Deposits of Medium and High Hardness. I. M. Vagapov. *Svarochnoe Proizvodstvo*, 1955, no. 2, Feb., p. 16-20.

Composition, structure and optimum conditions of operation; physical properties of deposited metal. Tables, graphs, micrographs. (L24, Q9)

255-L. (Russian.) Influence of Hydro-polishing on the Properties of Steel Parts in Operation. E. A. Satel' and M. A. Elizavetin. *Vestnik Mashinostroeniia*, v. 35, no. 2, Feb. 1955, p. 51-55.

Method, uses and advantages of polishing by a jet of liquid with admixture of fine abrasive. Graphs, diagrams, micrographs. (L10, ST)

256-L. (Russian.) Electric-Spark Protective Coating as a Method of Increasing Erosion Resistance of Thermohydraulic Power Installations. A. D. Moiseev. *Vestnik Mashinostroeniia*, v. 35, no. 2, Feb. 1955, p. 55-57.

Types of alloy adaptable for and advantages of such treatment. Table, micrographs. 3 ref. (L general, AY)

257-L. Electroless Nickel Plating Evaluated. Joseph Haas. *American Machinist*, v. 99, Mar. 14, 1955, p. 158-159.

Relative costs; advantages and disadvantages; bath compositions; applications of the process. Diagram. (L14, Ni)

258-L. Metallic Coatings on Non-Metallic Materials. I. Copper Films. *Industrial Finishing (London)*, v. 8, Feb. 1955, p. 94, 96, 98-99.

Thermal and chemical deposition of copper films on glass, ceramics and plastics. (L25, Cu)

259-L. Diverse Properties Extend Engineering Uses of Nickel Plating. J. B. Mohler. *Iron Age*, v. 175, Mar. 10, 1955, p. 100-103.

Review of baths, equipment and plating methods. Properties and applications of nickel and nickel alloy coatings. Photographs, tables, graphs. (L17, Ni)

260-L. Stannous-Fluoride Complexes in a Tin-Nickel Electrolyte. F. A. Brook, A. E. Davies and J. W. Price. *Journal of Applied Chemistry*, v. 5, Feb. 1955, p. 81-84.

Studies to determine mechanism of electrodeposition of alloys. Transport numbers of various ions in a chloride-fluoride tin-nickel electrolyte measured by the Hittorf method. Tables. 10 ref. (L17, Ni, Sn)

261-L. Design Specifications for Chromium Plating Thickness. J. B. Mohler. *Machine Design*, v. 27, Mar. 1955, p. 161-164.

Thickness requirements for various applications. Diagrams, tables. 3 ref. (L17, Cr)

262-L. Periodic Reverse Current Electroplating. Alan Whittaker. *Machinery (London)*, v. 86, Feb. 25, 1955, p. 416-420.

Process, based on reversal of polarity of plated piece, permits bright, surface leveling deposits to be produced at high speeds. Table. (L17, Cu, Ag, Zn, Cd, Au)

263-L. Chromium Diffusion Combats Corrosion, Heat, and Wear. Jack Hollingum. *Machinist (London)*, v. 99, Mar. 4, 1955, p. 361-367.

Coating methods; properties of coatings; applications. Photographs, micrographs, graphs. (L15, CN, AY, Cr)

264-L. Inhibited Acids in Plating Cycles. J. W. Carroll. *Metal Finishing*, v. 53, Mar. 1953, p. 60-63.

Advantages of inhibitors in baths on adhesion and appearance of deposit. Tables. 3 ref. (L17, Ni, ST)

265-L. Electroplating for Shelf Life. J. B. Mohler. *Metal Finishing*, v. 53, Mar. 1955, p. 64-67, 72.

Types of coatings recommended for manufactured products depending on costs, thickness, appearance, environment and life. Graphs, tables, photographs. 1 ref. (L17, ST, Zn, Cd, Sn, Ni, Cr, Cu, Pb)

266-L. Continuous Pickling Stainless Steel. Francis F. Jaray. *Metal Finishing*, v. 53, Mar. 1955, p. 68-72.

Operating procedure of a unique British pickling plant. Photographs. (L12, SS)

267-L. Surface Treatment and Finishing of Light Metals. V. Chemical Conversion Coatings. S. Wernick and R. Pinner. *Metal Finishing*, v. 53, Mar. 1955, p. 73-77.

Chemical oxidation of tubes; chromate and phosphate processes; comparison of chemical oxide conversion coatings. Tables. 124 ref. (L14, Al)

268-L. Electroplating Equipment. Robert Allen. *Metal Industry*, v. 86, Feb. 25, 1955, p. 147-150.

Layout; installation; maintenance. Photographs. (L17)

269-L. Plating Jigs. J. John Preston. *Metal Industry*, v. 86, Mar. 11, 1955, p. 189-191.

Material; insulation; design; application. Diagrams, tables. (L17)

270-L. Epoxy Coatings for Metal Decorating Finishes. M. A. Glaser, E. J. Bromstead and G. L. Weaver. *Official Digest, Federation of Paint and Varnish Production Clubs*, v. 27, Jan. 1955, p. 3-9.

Characteristics and applications. Tables, photograph. (L26)

271-L. Evaluation of Etch Primers in Metal Coating Systems. *Products Finishing*, v. 19, Mar. 1955, p. 42 + 6 pages.

Surface preparation and conditions for effective use of pretreatment primers. Tables. (L26, Al, CN, Fe, Zn, Cd, SS, Ag, Au)

272-L. Hot Dip Galvanizing Is a Science. H. Wallace G. Imhoff. *Wire*

and Wire Products, v. 30, Mar. 1955, p. 295-297.

Effect of base-metal thickness and immersion time on coating thickness. Graphs, tables. (L16, Zn)

273-L. Calculation of Modern Continuous Pickling Plants. W. Fackert. *Henry Bratcher Translation No. 3431*, 29 p. (Slightly abridged from *Stahl und Eisen*, v. 72, no. 20, 1952, p. 1196-1207.) Henry Bratcher, Altadena, Calif.

Previously abstracted from original. See item 958-L, 1952. (L12, ST)

274-L. Acid Pickling—A Closed-Cycle Process? W. Fackert. *Henry Bratcher Translation No. 3432*, 15 p. (Slightly abridged from *Stahl und Eisen*, v. 74, no. 14, 1954, p. 888-894.) Henry Bratcher, Altadena, Calif.

Previously abstracted from original. See item 684-L, 1954. (L12)

275-L. Electrodeposition of Chromium. A. T. Vagarmyan and D. N. Usachev. *Henry Bratcher Translation No. 3441*, 5 p. (From *Doklady Akademii Nauk SSSR*, v. 98, no. 4, 1954, p. 605-607.) Henry Bratcher, Altadena, Calif.

Previously abstracted from original. See item 45-L, 1955. (L17, Cr)

276-L. (French.) Study of the Overvoltage of Cadmium in Solutions of Cadmium Sulfate. Anne-Marie Baticle. *Comptes rendus*, v. 240, no. 7, Feb. 14, 1955, p. 763-765.

Overvoltage curves plotted for cadmium cathodes in solutions of cadmium sulfate and in presence of excess of sulfuric acid. Graph. (L17, Cd)

277-L. (French.) Surface Preparation of Ferrous Metals. J. Liger. *Métallurgie et la construction mécanique*, v. 87, no. 2, Feb. 1955, p. 119, 121-122. Sand-blasting and shot-peening; surface properties after treatment. (L10)

278-L. (French.) Pickling Inhibitors and Accelerators. G. Rossi-Landi. *Métallurgie et la construction mécanique*, v. 87, no. 2, Feb. 1955, p. 125, 127.

Role of inhibitors and accelerators in chemical cleaning of steel. (L12, ST)

279-L. (French.) Bulk Anodic Oxidation and Coloring of Small Light Alloy Pieces. Charles Etienne. *Revue de l'aluminium*, v. 32, no. 217, Jan. 1955, p. 71-79.

Treating of small parts in baskets reduces cost of operation. Diagrams, photographs. (L19, Al)

280-L. (French and German.) Copper Anodes for Galvanic Baths. H. Bover. *Pro-Metal*, v. 7, no. 43, Feb. 1955, p. 452-456.

Compositions and properties of copper anodes and baths for various plating conditions. Photograph. 6 ref. (L17, Cu)

281-L. (German.) The Current State of Phosphatizing Iron and Non-Ferrous Metals. Willi Machu. *Werkstoffe und Korrosion*, v. 6, no. 2, Feb. 1955, p. 72-79; disc., p. 79-80.

Value of phosphate coatings to prevent corrosion, reduce friction and as a paint base. Photographs. 27 ref. (L14)

282-L. (German.) Chemical Polishing of Brass and German Silver. III. Chemistry of the Polishing Process. Gerhard Schmid and Heinz Spähn. *Zeitschrift für Metallkunde*, v. 46, no. 2, Feb. 1955, p. 128-137.

Dependence of the dissolution rate and the formation of nitrous acid upon the water content; composition of gases formed during polishing; activity measurements; theory of chemical polishing. Graphs, diagram. 14 ref. (L12, Cu, Zn, Ni)

283-L. Electrochemical Behavior of a Titanium-Fused Salt-Platinum Cell. M. E. Straumanis and A. W. Schlechten. *Electrochemical Society, Journal*, v. 102, Mar. 1955, p. 131-136.

Studies of the action of air and moisture during titanium electrolysis. Diagrams, tables, graph. 7 ref. (L17, Ti)

284-L. Aluminum Coating Process Developed for Iron and Steel Wire. Bernard S. Westerman. *Iron and Steel Engineer*, v. 32, Mar. 1955, p. 126, 129-130.

Equipment and operating procedures. Diagram, photograph. (L15, Al, Fe, ST)

285-L. (Book.) Chromium Electroplating. 159 p. PB 111514. Office of Technical Services, U. S. Department of Commerce, Washington, D. C. \$5.00.

Investigates the fundamental principles of chromium deposition and evaluates conditions existing in plating baths from the standpoint of thermodynamic and reaction rate theory. (L17, Cr)

286-L. (Book.) Flow-Coating. E. A. Zahn. 295 p. PB 111514. Research Press, Dayton, Ohio. \$6.50.

A detailed account of specific problems, flow-coater, design, finishing methods, and selection of paints and solvents for industrial finishing processes. (L26)

287-L. (Book.) The Measurement and Control of Industrial Paint Finishing Costs. 60 p. 1955. Imperial Chemical Industries Ltd., London S. W. 1, England.

Three papers on ways of reducing painting costs. (L26)

M Metallography, Constitution and Primary Structures

130-M. Solid Solution Equilibria in the Zirconium-Hydrogen System. Russell K. Edwards, P. Levesque and D. Cubicciotti. *American Chemical Society, Journal*, v. 77, Mar. 5, 1955, p. 1307-1311.

Phases of the system, zirconium-hydrogen determined from 1 to 760 mm. of mercury and from 600 to 900° C. Tables, graphs, phase diagram. 14 ref. (M24, Zr, H)

131-M. Dislocations in Germanium Crystals. F. Lincoln Vogel, Jr. *Bell Laboratories Record*, v. 33, Mar. 1955, p. 104-107.

Dislocation theory; effects of dislocations on semiconducting properties. Photographs, diagram, micrograph. (M26, Ge)

132-M. Pseudo-Binary Phase Sections Between Laves Phases in Ternary Alloys of Uranium. G. B. Brook, G. I. Williams and E. M. Smith. *Institute of Metals, Journal*, v. 83, Feb. 1955, p. 271-276 + 2 plates.

Phase boundaries at 700 and 900° C. determined in the pseudo-binary systems U-Mn-UNi₂, U-Fe-UNi₂ and U-Co-UNi₂. Tables, graphs, photographs, micrographs. 16 ref. (M24, U)

133-M. The Constitution of Uranium-Zirconium Alloys. D. Summers-Smith. *Institute of Metals, Journal*, v. 83, Feb. 1955, p. 277-282 + 1 plate.

Study of phases by metallographic, dilatometric and X-ray methods, using alloys prepared by arc melting. Graph, tables, micrographs. 12 ref. (M24, U, Zr)

134-M. (English.) Phase and Structural Relations in the System Iron Tellurium. Fredrik Gronvold, Haakon

Haraldsen and John Vihovde. *Acta Chemica Scandinavica*, v. 8, no. 10, 1954, p. 1927-1942.

Alloys from 12 to 47% iron studied by X-ray diffraction. Tables, diagrams, graph. 25 ref. (M24, M27, Fe, Te)

135-M. (French.) Relationship Between X-Ray Diffraction Diagrams and Micrographic Appearance of a Polygonized Aluminum Crystal. Christian de Beaulieu. *Comptes rendus*, v. 240, no. 5, Jan. 31, 1955, p. 522-524.

Pure crystals polygonized by prolonged annealing show that the relative disorientation of blocks may present different appearances according to the crystallographic planes studied. Micrographs. (M26, Al)

136-M. (French.) Determination by Electron Diffraction of the Structure of Oxide Films Formed on the Surface of Iron. Jean Moreau and Jean Bardolle. *Comptes rendus*, v. 240, no. 5, Jan. 31, 1955, p. 524-526.

Oxide films formed at 250 to 700° C. similar to those formed under more favorable conditions. 8 ref. (M27, Fe)

137-M. (German.) Investigations of the Structure of Steel With the Small Electron Microscope. Ernst Kinder. *Archiv für das Eisenhüttenwesen*, v. 26, no. 2, Feb. 1955, p. 113-116.

Comparison with results from optical and large electron microscope. Micrographs. 9 ref. (M27, M21, ST)

138-M. (German.) Basic Processes of Magnetization in Permanent Alnico Magnet Alloys. Hermann Fahlenbrach. *Naturwissenschaften*, v. 42, no. 3, Feb. 1955, p. 64-65.

Electron microscopic investigation of structures in an optimum magnetic state. Micrographs. 2 ref. (M27, P16, SG-n)

139-M. (German.) Measurement of Lattice Constants With Electron Beams on Thin Films of Silver. V. Hauk and A. Krings. *Naturwissenschaften*, v. 42, no. 3, Feb. 1955, p. 68-69.

Experimental data and comparison with results obtained by other authors; factors affecting lattice-constant measurements. Graph. 7 ref. (M26, Ag)

140-M. (German.) A New Point of View on the Problem of the Bonding State of Interstitial Structures. Konrad Schubert. *Zeitschrift für Metallkunde*, v. 46, no. 2, Feb. 1955, p. 100-109.

Simple structures with A-1 correlation; structures with one local correlation, which deviated little from a A-1 correlation; simple structures with B-1 correlation; percarbides and related compounds; complex structures with B-1 and A-1 structures. Diagrams. 33 ref. (M26)

141-M. (German.) Gold-Palladium-Copper Alloys. Ernst Raub and Georg Wörwag. *Zeitschrift für Metallkunde*, v. 46, no. 2, Feb. 1955, p. 119-128.

X-ray, metallographic, and electrical resistance data to determine phase diagrams. Tables, micrographs, graphs. 13 ref. (M24, Au, Pd, Cu)

142-M. (Italian.) New Etching Reagents for Certain Types of Ferritic, Semiferritic, Martensitic, and Austenitic Stainless Steels. G. Catella and C. Giometto. *Metallurgia italiana*, v. 47, no. 1, Jan. 1955, p. 19-20.

Specific reagents for revealing specific structures. Table, micrographs. (M21, SS)

143-M. (Swedish.) Metallographic Analysis and Its Application to Steel. Sakari Heiskanen. *Jernkontorets Annaler*, v. 139, no. 2, 1955, p. 78-134.

Methods for isolating and study-

ing carbides and nonmetallic inclusions. Graphs, diagrams, micrographs, tables. 29 ref. (M general, ST)

144-M. Investigation of Segregation in Cast Irons by Radiographic Techniques. Jerome Cohen, Eugene Hall, Laurence Leonard and Robert Ogilvie. *Nondestructive Testing*, v. 13, Mar.-Apr. 1955, p. 33-34.

Utilization of microradiography in the metallographic study of metal structures. Photographs, micrographs. (M23, CI)

145-M. (Russian.) Structure of Superconductors. VIII. X-Ray and Metallographic Investigation of the Bismuth-Rhodium System. N. N. Zhuravlev and G. S. Zhdanov. *Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki*, v. 28, no. 2, Feb. 1955, p. 228-235 + 2 plates; disc., p. 235-236.

Phase characteristics, solubilities, densities and microhardness determined for three compounds, with polymorphic modifications according to temperature. Micrographs, tables, phase diagram, graph. 15 ref. (M24, N6, P10, Q29, Bi, Rh)

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Transformations and Resulting Structures

162-N. (Polish.) Spontaneous and Accelerated Aging of Steel Wires. Zygmunt Steininger. *Hutnik*, v. 21, no. 11, Nov. 1954, p. 346-352.

Effects of aging and subsequent surface deformation on tensile and torsional properties. Tables, graphs. 15 ref. (N7, Q23, Q1, ST)

163-N. (Russian.) Variations in the Intensity of X-Ray Interference During the Aging of Nickel-Chromium-Titanium-Aluminum Alloy. G. V. Kurdiymov and N. T. Travina. *Zhurnal Tekhnicheskoi Fiziki*, v. 25, no. 2, Feb. 1955, p. 182-187.

Effects of quenching at 1000° C., followed by aging at 500 to 800° C. Tables, graphs. 7 ref. (N7, N1, Cr, Ti, Al)

164-N. (Russian.) Influence of the Cooling Rate on the Kinetics of the Transformation of Austenite Into Martensite. A. P. Guliaev and A. P. Akshentseva. *Zhurnal Tekhnicheskoi Fiziki*, v. 25, no. 2, Feb. 1955, p. 299-312.

Data for a chromium-vanadium steel cooled to room and subzero temperature. Tables, graphs, micrographs. 7 ref. (N8, AY)

165-N. The Metastability of Austenite in an 18/8 Cr-Ni Alloy. B. Cina. *Iron and Steel Institute, Journal*, v. 179, Mar. 1955, p. 230-239 + 6 plates.

Investigations by metallographic, thermomagnetic and room and high-temperature X-ray diffraction methods. Micrographs, photograph, tables, graphs. 16 ref. (N8, SS)

166-N. The Kirkendall Effect in Metals. Possible Applications to Solve Porosity and Plating Problems. K. Sachs. *Metal Treatment and Drop Forging*, v. 22, Mar. 1955, p. 119-125.

Experimental evidence and theories of diffusion of solid metals. How the formation of diffusion micropores, and the heating of such discontinuities in the lattice, associated with the phenomena, can be applied in considering porosity in powder metallurgy and the plating of alloys. Graphs, table, diagrams. 25 ref. (N1 H11, L general)

167-N. Supercooling of Transformation Process as a Basis for the Martensite Transformation. I-II. E. Houdremont and O. Kriselement. *Henry Brucher Translation Nos.* 3339-3340, 69 p. (Slightly condensed from *Archiv für das Eisenhüttenwesen*, v. 24, nos. 1-2, 1954, p. 53-67.) Henry Brucher, Altadena, Calif.

Study of forces and mechanisms involved in martensite reactions. Graphs. 37 ref. (N8, ST)

168-N. On the Irreversibility of Iron-Nickel Alloys. E. Scheil. *Henry Brucher Translation No.* 3349, 20 p. (Slightly condensed from *Archiv für das Eisenhüttenwesen*, v. 24, nos. 3-4, 1953, p. 153-160.) Henry Brucher, Altadena, Calif.

Previously abstracted from original. See item 198-N, 1953. (N6, Fe, Ni)

169-N. Metallographic Studies of Hard Chromium Deposits. L. Koch and G. Hein. *Henry Brucher Translation No.* 3422, 7 p. (From *Metall-oberfläche*, v. 7, no. 10, 1953, p. 145-148.) Henry Brucher, Altadena, Calif.

Previously abstracted from original. See item 315-N, 1953. (N6, Cr, Cu, ST)

170-N. (English.) Growth of Potassium Halide Crystals From Aqueous Solution. J. B. Newkirk and G. W. Sears. *Acta Metallurgica*, v. 3, no. 1, Jan. 1955, p. 110-111.

Explanation of formation of rods, platelets or parallelepipeds by a new growth mechanism. 4 ref. (N12)

171-N. (French.) Supersaturation of Vacancies During Diffusion in Brass. André Accary. *Comptes rendus*, v. 240, no. 5, Jan. 31, 1955, p. 519-522.

Determination based on kinetics of formation of microscopic porosities appearing in the zone of diffusion. Micrograph, graphs. 5 ref. (N1, Cu)

172-N. (French.) Kinetics of the Martensitic Transformation in a Ferromagnetic Alloy. Jean Philibert. *Comptes rendus*, v. 240, no. 5, Jan. 31, 1955, p. 529-531.

Effects resulting upon varying the carbon and nitrogen contents. Graphs. 3 ref. (N8, Fe, Ni)

173-N. (French.) Eutectoid Transformation of a Copper Alloy With 6% Beryllium. Arunachala Viswanathan. *Comptes rendus*, v. 240, no. 6, Feb. 7, 1955, p. 626-628.

Verifies different methods of transformation by quenching and tempering of copper and beryllium alloys in the beta-phase. 2 ref. (N9, Cu, Be)

174-N. (French.) Present State of Metallography of Alloyed Austenites, Particularly in Steels Type 18-8. IV. Austenite Stabilization and Sensitization of Martensite. Paul Bastien and Jacques Dedieu. *Métaux, Corrosion-Industries*, v. 30, no. 353, Jan. 1955, p. 1-8.

Phenomena in transformation of austenite to martensite. Micrograph, graphs, table. (N8, SS)

175-N. (French.) Structural Hardening of Aluminum, 4% Copper Alloys. Adrien Saulnier. *Revue de l'Aluminium*, v. 32, no. 21, Jan. 1955, p. 41-46.

Theory of precipitation hardening. Metallographic and X-ray confirmation of the mechanism. Graphs, micrographs. 15 ref. (N7, Al, Cu)

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Effect of quenching, aging and recrystallization due to cold working upon mechanical and physical

properties, solubility and diffusion; theory of aging and precipitation. Graphs. 123 ref. (N7, P general, Q general, CN)

177-N. (German.) Orientation Connections Between Austenite, the Intermediate Stage, and Martensite. Wilhelm Hofmann and Günter Schuhmacher. *Archiv für das Eisenhüttenwesen*, v. 26, no. 2, Feb. 1955, p. 99-104.

Radiographic investigation of chromium-vanadium steel. Radiographs, diagrams. 9 ref. (N8, AY)

178-N. (German.) Crystallization of Ledeburite Eutectic. Erich Scheil and Dieter Pohl. *Archiv für das Eisenhüttenwesen*, v. 26, no. 2, Feb. 1955, p. 105-108.

Significance of silicon content for undercooling; hardness and structures of refined cast iron. Graphs, micrographs. 11 ref. (N12, M27, Q29, CI)

179-N. (German.) Oriented Precipitates of Secondary Graphite in Gray Cast Iron. Wilhelm Hofmann and J. M. Sistiaga. *Archiv für das Eisenhüttenwesen*, v. 26, no. 2, Feb. 1955, p. 109-112.

Occurrence and origin; relation of orientation with austenite; growth of monocrystals from gray iron. Graphs, micrographs, photograph. 6 ref. (N8, CI)

180-N. (German.) The Equilibrium Between Oxygen and Sulfur in Molten Copper at 1150° C. Friedrich Johannsen and Ulrich Kuxmann. *Zeitschrift für Erzbergbau und Metallhüttenwesen*, v. 8, no. 2, Feb. 1955, p. 45-59.

Method and apparatus for measuring solubility of sulfur dioxide; equilibrium reactions over a wide concentration range and at different gas pressures; combining conditions for oxygen and sulfur atoms in the melt. Graphs, diagram, photographs, tables. 20 ref. (N12, Cu)

181-N. (German.) Nucleus Formation and Rate of Growth During the Recrystallization of Pure Aluminum. Frank Haessner and Kurt Lücke. *Zeitschrift für Metallkunde*, v. 46, no. 2, Feb. 1955, p. 110-118.

Studies on thin aluminum wire show effects of temperature, time, degree of deformation and amount of impurities. Graph, tables, photograph. 28 ref. (N2, N5, Al)

182-N. (Italian.) Reactions in the Solid State Between Metal and Inclusions. R. Zoja. *Metallurgia italiana*, v. 47, no. 1, Jan. 1955, p. 15-18.

Behavior of nonmetallic inclusions in refined ferrochromium, other ferroalloys and steels. Table, graph, micrographs. 7 ref. (N11, Fe, Cr, ST)

183-N. Solubility of Oxygen in Liquid Nickel and Fe-Ni Alloys. Henry A. Wriedt and John Chipman. *Journal of Metals*, v. 7; *American Institute of Mining and Metallurgical Engineers, Transactions*, v. 203, Mar. 1955, p. 477-479.

Oxygen analyses made on samples from melts made in a 30-lb. induction furnace. Tables, graphs. 13 ref. (N12, Fe, Ni)

P

Physical Properties and Test Methods

134-P. (Russian.) Dependence of Electric Conductivity and Electron Emission on the Energy of a Metal in the Process of Heating by a High Den-

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135-P. The Heat of Formation of InSb. O. J. Kleppa. *American Chemical Society, Journal*, v. 77, Feb. 20, 1955, p. 897-898.

Determined during a study of tin solution calorimetry. Table. 2 ref. (P12, In, Sb)

136-P. Unit Weights of Metals. George Sorkin and Willard H. Hawley, Jr. *Machine Design*, v. 27, Mar. 1955, p. 205-207.

Data sheet covering more than 240 types of ferrous and nonferrous metals. (P10, S22)

137-P. X-Ray Critical-Absorption and Emission Energies in Kev. S. Fine and C. F. Hendee. *Nucleonics*, v. 13, Mar. 1955, p. 36-37.

Data for 100 elements. Table. 6 ref. (P10)

138-P. Thermal Conductivity of Indium-Thallium Alloys at Low Temperatures. Ronald J. Sladek. *Physical Review*, v. 97, ser. 2, Feb. 15, 1955, p. 902-915.

Measurements made on alloys containing up to 50 at. % of thallium. Tables, diagram, graphs. 51 ref. (P11, In, Ti)

139-P. Review of Experimental Investigations of Liquid-Metal Heat Transfer. Bernard Lubarsky and Samuel J. Kaufman. *U. S. National Advisory Committee for Aeronautics, Technical Note* 3336, Mar. 1955, 115 p.

Theoretical analysis of published experimental data. Considerable spread observed between experimental results and predictions of theoretical calculations. Graphs, tables. 41 ref. (P12)

140-P. Gases in Metals. P. Bardeheuer. *Henry Brucher Translation* No. 3440, 15 p. (From *Metall*, v. 6, nos. 13-14, 1952, p. 351-356.) Henry Brucher, Altadena, Calif.

Previously abstracted from original. See item 454-P, 1952. (P12, E25)

141-P. (French.) Relation Between the Temperature of a Ferromagnetic Substance and the Heat Dissipated Internally by an Alternating Field. Gustave Ribaud and Denise Bordier. *Comptes rendus*, v. 240, no. 7, Feb. 14, 1955, p. 703-707.

A ferromagnetic substance placed in a high frequency alternating field is heated by Foucault currents and hysteresis, and heat dissipation studied as a function of temperature. Graphs. 2 ref. (P16, Fe)

142-P. (French.) Determination of the Activities of Copper and Gold in Their Alloys. Daniel Balesdent. *Comptes rendus*, v. 240, no. 7, Feb. 14, 1955, p. 760-762.

Study of the reduction equilibrium of copper sulfide by hydrogen in the presence of gold. Table. 6 ref. (P12, Cu, Au)

143-P. (German.) Electron Emission of Metal Surfaces After Mechanical Working. J. Lohff and H. Raether. *Naturwissenschaften*, v. 42, no. 3, Feb. 1955, p. 66-67.

Relationship of magnitude of electron emission to position of the metals in the periodic system. Table, graph. 5 ref. (P15)

144-P. The Electrical Resistance of Dilute Copper Alloys at Very Low Temperatures. Guy K. White. *Canadian Journal of Physics*, v. 33, Mar.-Apr. 1955, p. 119-124.

Description of adiabatic demagnetization cryostat. Measurements

near 1° K. Diagram, graph. 12 ref. (P15, Cu)

145-P. Electrical Conduction in Molten Cu-Fe Sulfide Mattes. G. M. Pound, G. Derge and G. Osuch. *Journal of Metals*, v. 7; *American Institute of Mining and Metallurgical Engineers, Transactions*, v. 203, Mar. 1955, p. 481-484.

Investigation of mode of electrical conduction as an aid in structure determinations. Diagrams, tables, graph, circuit diagram. 16 ref. (P15, M25, Cu)

146-P. Activities in the Iron Oxide-Silica-Lime System. John F. Elliott. *Journal of Metals*, v. 7; *American Institute of Mining and Metallurgical Engineers, Transactions*, v. 203, Mar. 1955, p. 485-488.

Thermodynamic studies of behavior of phases in molten slag system. Graphs. 15 ref. (P12, B21, ST)

147-P. The Temperature Dependence of Magnetostriction in a Nickel Crystal. W. D. Corner and G. H. Hunt. *Physical Society, Proceedings*, v. 68, no. 423A, Mar. 1955, p. 133-144.

Measurements of longitudinal magnetostriction of specimens over the temperature range -180 to 360° C. Diagrams, tables, graphs. 18 ref. (P16, Ni)

148-P. Apparatus for Measuring the Thermal Conductivity of Metals in Vacuum at High Temperatures. Marvin Moss. *Review of Scientific Instruments*, v. 26, Mar. 1955, p. 276-280.

Equipment measures both axial temperature gradient and transfer of heat under steady state conditions in a thermally shielded cylindrical rod of the metal which is heated at one end and cooled at the other. Diagram, table, graphs. 2 ref. (P11)

149-P. (Book.) Modern Aspects of Electrochemistry. J. O'M. Bockris. 344 p. 1954. Academic Press Inc., 125 East 23rd St., New York 10, N. Y. \$6.80.

Recent theoretical and practical developments in our understanding of electrochemical problems. (P15)



Mechanical Properties and Test Methods; Deformation

417-Q. (Russian.) Results of Observations of Metal and Alloy Micro-Structures During Deformation Under Tensile Stress at High Temperature. M. G. Lozinskii. *Izvestia Akademii Nauk SSSR, Otdelenie Tekhnicheskikh Nauk*, 1954, no. 10, Oct., p. 3-13 + 2 plates.

Description of method and equipment for testing at temperatures of 400 to 1000° C. Diagrams, photographs, micrographs. 9 ref. (Q27, M27)

418-Q. (Russian.) Behavior of a Thin Surface Layer of Metal in a Zone of Stress Concentration. V. I. Mokeeva and B. M. Rovinskii. *Izvestia Akademii Nauk SSSR, Otdelenie Tekhnicheskikh Nauk*, 1954, no. 10, Oct., p. 14-22 + 1 plate.

Interference pattern method of determining yield point and residual deformation. Diagrams, graphs, table. 7 ref. (Q25)

419-Q. (Russian.) Influence of Chemical Composition of Cast Iron on Wear Resistance of Brake Shoes. D. T. Zelenskii. *Litneoe Proizvodstvo*, 1955, no. 2, Feb., p. 7-10.

Influence of carbon, silicon, manganese, phosphorus and sulfur contents; method of casting; optimum hardness. Tables, diagrams, micrographs. 4 ref. (Q9, CI)

420-Q. (Russian.) Characteristics of "Ultimate Cycles" in the True Stress-strain Diagram. L. I. Savel'ev. *Vestnik Mashinostroeniia*, v. 35, no. 2, Feb. 1955, p. 14-17.

Interpretation of a diagram of "ultimate cycles" as a means to determine the fatigue characteristics of materials. Tables, graphs, diagrams. 8 ref. (Q7, ST)

421-Q. (Russian.) Influence of Carbide-Forming Elements on the Annealing Brittleness of Steel. V. I. Prosvirin and E. I. Kvashnina. *Vestnik Mashinostroeniia*, v. 35, no. 2, Feb. 1955, p. 58-67.

Experimental data on the effects of chromium, manganese, molybdenum, tungsten, columbium, vanadium and titanium carbides. Graphs, diagrams, tables, micrographs. 10 ref. (Q23, M26, ST)

422-Q. (Russian.) Investigation of Strength of Heat Treated Tool Steel Under Tensile and Compressive Stresses. Z. M. Konushko. *Vestnik Mashinostroeniia*, v. 35, no. 2, Feb. 1955, p. 67-69, 73.

Test methods for investigating influence of heat treatment condition on the strength. Tables, diagrams, graphs. 4 ref. (Q23, J general, TS)

423-Q. (Russian.) Strengths of Bond and Distortions in Crystals of Martensite. V. K. Kritskaya, G. V. Kurdimov and N. M. Nodia. *Zhurnal Tekhnicheskoi Fiziki*, v. 25, no. 2, Feb. 1955, p. 177-181.

Limits of elastic deformation in martensite and alpha-iron; effects of carbon content and temperature. Table, graph. 9 ref. (Q21, M26, ST)

424-Q. (Russian.) Problem of the Physical Nature of Cavitation Fracture. L. A. Glikman, V. P. Tekht and Iu. E. Zobachev. *Zhurnal Tekhnicheskoi Fiziki*, v. 25, no. 2, Feb. 1955, p. 280-298 + 1 plate.

Metallographic, X-ray and microhardness study of carbon and austenitic steels, high strength cast iron and brass. Photograph, micrographs, graphs, tables. 9 ref. (Q26, ST, CI, Cu)

425-Q. (Russian.) Hardness and Stress in a Plastically Deformed Body. A. M. Rozenberg and L. A. Khvorostukhin. *Zhurnal Tekhnicheskoi Fiziki*, v. 25, no. 2, Feb. 1955, p. 313-322.

Shows that the numerical value of indentation hardness is a function of total deformation of the material; relation to machinability. Graphs, table, diagram. 10 ref. (Q29, Q25, G17, ST, CI, Al, Cu)

426-Q. The Yield Rate of Mild Steel. Frederick Forscher. *ASTM Bulletin*, 1955, no. 205, Apr., p. 63-67.

Dependence of the yield rate on stress and temperature. Effect of nucleation and growth of Lüders' bands. Tables, graphs, diagrams, photograph. 5 ref. (Q23, Q24, ST)

427-Q. A Study of the Thermal Stability of Materials Used in Sintering Machine Pallets. J. B. Caine. *Blast Furnace and Steel Plant*, v. 43, Mar. 1955, p. 315-319.

Tests on three cast irons and two cast steels at temperatures of 1250, 1450 and 1650° F. Tables, graph, micrographs. (Q23, CI)

428-Q. Some Flexural Fatigue Tests on 75S-T Aluminium Alloy Sheet Specimens With Drilled Holes. J. M. Finney and J. Y. Mann. *Commonwealth of Australia, Dept. of Supply, Research and Development Branch, A.R.L./S.M.* 213, Nov. 1954, 8 p. + 8 plates.

Tests on unmatched specimens of clad and unclad 75S-T aluminum alloy and unclad 75S-T aluminum alloy with various stress concentrators. Tables, diagrams, photograph, graphs. 6 ref. (Q7, Al)

429-Q. Plastic Strain and Stress Relations at High Temperatures. I. A. E. Johnson, N. E. Frost, and J. Henderson. *Engineer*, v. 198, Mar. 18, 1955, p. 366-369.

Studies of the plastic-strain-stress relations for a 0.17% C steel at 350 and 450° C., and an RR59 aluminum alloy at 20, 150 and 200° C. under both simple and general complex stress loading conditions. Graphs, tables. (To be continued.) (Q27, CN, Al)

430-Q. The Comet and Design Against Fatigue. W. J. Duncan. *Engineering*, v. 179, Feb. 18, 1955, p. 196-200.

Attempts to formulate some of the important technical conclusions of the Comet inquiry and reviews subject of the fatigue of metals and its implications for engineering design. (Q7)

431-Q. The Thickness of High-Temperature Steam Pipes. Design Stresses for Creep Conditions. J. S. Blair. *Engineering*, v. 179, Feb. 18, 1955, p. 205-209.

Design formulas for temperatures from about 950 to 1070° F. Graphs, tables. (Q3, AY)

432-Q. The Energy Theorems of Structural Analysis. I. Definitions and Fundamentals. II. Derivation and Discussion of the Theorems. E. H. Brown. *Engineering*, v. 179, Mar. 11, 1955, p. 305-308; Mar. 18, 1955, p. 339-342.

Study of the various theorems of strain energy and complementary energy, with their physical meanings, conditions and limitations. Considers structures with either linear or nonlinear load/displacement curves. Graphs. 13 ref. (To be continued.) (Q25)

433-Q. Sonic Methods for Measuring Young's Modulus of Elasticity of Porcelain Enamel-Metal Composites. Robert E. Cowan. *Finish*, v. 12, Apr. 1955, p. 40-42, 62-64.

Equipment and test methods. Graphs, diagrams, photographs, table. 10 ref. (Q21, L27)

434-Q. How Titanium Alloys Behave at High Temperatures. D. R. Luster and B. L. Shakely. *Iron Age*, v. 175, Mar. 24, 1955, p. 96-99.

Determination of notch, creep and fatigue characteristics at temperatures up to 100° F. Graphs, table. (Q23, Q3, Q7, Ti)

435-Q. Trace Impurities. Effect on the Properties of Iron. N. P. Allen. *Iron & Steel*, v. 28, Mar. 1955, p. 85-88.

Effects on mechanical properties including ductility, tensile and impact properties. Graph, photographs, tables. (Q23, Q6, Fe)

436-Q. Causes of Variable Creep Strength in Basic O.H. Carbon Steel. W. E. Bardgett and M. G. Gemmill. *Iron and Steel Institute, Journal*, v. 179, Mar. 1955, p. 211-219.

Effect of manufacturing variables on scatter of results obtained under similar testing conditions in mild steels. Shows that soluble aluminum present in the steel is a paramount factor in variable creep behavior. Tables, graphs. 9 ref. (Q3, CN)

437-Q. Anisotropic Loading Functions for Combined Stresses in the Plastic Range. L. W. Hu and Joseph Marin. *Journal of Applied Mechanics*, v. 22, Mar. 1955, p. 77-85.

Validity of loading functions for

24S-T in bi-axial tension. Diagrams, graphs, table. 20 ref. (Q27, Al)

438-Q. Effect of Low Temperatures on the Mechanical Properties of a Commercially Pure Titanium. Glenn W. Geil and Nesbit L. Carwile. *Journal of Research, National Bureau of Standards*, v. 54, Feb. 1955, p. 91-101.

Results of tests on notched and unnotched tensile specimens at -196 to +100° C. Table, micrographs, graphs. 10 ref. (Q general, Ti)

439-Q. Magnetic Measurement of the Hardness of Metals. D. Hadfield. *Metal Treatment and Drop Forging*, v. 22, Mar. 1955, p. 91-96.

Use of the magnetic characteristics of metals and alloys to define their hardness. Testing methods. Graphs. (To be continued.) (Q29)

440-Q. Metallurgical Aspects of the Comet Inquiry. Tom Bishop. *Metal Treatment and Drop Forging*, v. 22, Mar. 1955, p. 113-118.

Fatigue and other tests to ascertain cause of failure. Photographs, diagram, graph. (Q7)

441-Q. Ultrasonic Attenuation in Zinc Single Crystals While Undergoing Plastic Deformation. George A. Alers. *Physical Review*, v. 97, ser. 2, Feb. 15, 1955, p. 863-869.

Measurements were made at constant stress. The attenuation of transverse waves was very sensitive to the deformation. Diagrams, graphs. 5 ref. (Q24, Zn)

442-Q. The Embrittlement of Steel by Hydrogen. Winifred A. Bell. *Product Engineering*, v. 26, Mar. 1955, p. 189-192.

Effects of hydrogen penetration. Suggestions to minimize hydrogen attack. Photographs, graphs. (Q23, ST)

443-Q. Friction Between Unlubricated Metals: A Theoretical Analysis of the Junction Model. A. P. Green. *Royal Society, Proceedings*, v. 228, ser. A, Feb. 22, 1955, p. 191-204.

Stresses and deformations in surfaces subjected to sliding friction. Diagrams, graphs. 16 ref. (Q9)

444-Q. Fatigue of Metals—Our Knowledge and the Deficiencies in Our Knowledge. P. L. Teed. *Shell Aviation News*, 1955, no. 199, Jan., p. 16-25.

Effects of surface treatment and heat treating on fatigue properties. Tables, graphs. 109 ref. (Q7)

445-Q. Heat Treating Tool Steels. V. Hot Work and High Speed Types. H. C. Manley and G. E. Brumbach. *Steel*, v. 136, Mar. 14, 1955, p. 106-109.

Effect of heat treating parameters on hardness. Photograph, diagrams, graphs. (Q29, J general, TS)

446-Q. The Effects of Chromium, Iron, and Nickel on the Mechanical Properties of Zirconium. W. Chubb and G. T. Muehlenkamp. *U. S. Atomic Energy Commission BMI-938*, Aug. 1954, 19 p.

Tensile properties, hot hardness, and impact strength of arc-melted, binary alloys of iodide zirconium containing up to 1-wt. % chromium, iron or nickel have been investigated. The alloys were tested in the alpha-annealed condition. Tables, graphs. 6 ref. (Q general, Zr)

447-Q. Study of Effects of Microstructure and Anisotropy on Fatigue of 24S-T4 Aluminum Alloy. H. A. Lipsitt, G. E. Dieter, G. T. Horne and R. F. Mehl. *U. S. National Advisory Committee for Aeronautics, Technical Note* 3380, Mar. 1955, 42 p.

Experimental equipment, procedures and results. Tables, refractograms, micrographs, diagram, graphs. 16 ref. (Q7, Al)

448-Q. Brittle Fracture in Steel. II. An Introductory Summary. C. P. Oldridge. *Welding and Metal Fabrication*, v. 23, Mar. 1955, p. 103-111.

Testing procedures; notch properties; welding defects. Diagrams, graph, photographs. 122 ref. (Q23, K general, ST)

449-Q. (Dutch.) A Comparison of the Accuracy of Indication of the Flow Limit in "Rigid" and "Soft" Tensile Equipment. P. G. Rittershaus. *Metalen*, v. 10, no. 3, Feb. 15, 1955, p. 29-32.

Effects of testing machine characteristics on yield-point elongation measurements. Diagrams, graphs. (Q27, CN)

450-Q. (French.) The Overheating of Steel. Remy. *Centre de Documentation Siderurgique, Circulaire d'Informations Techniques*, v. 12, no. 2, 1955, p. 407-429.

Methods of detecting overheating, its causes and influence on mechanical properties. Photograph, micrographs, graphs. 42 ref. (Q general, ST)

451-Q. (French.) Direct Determination of Brittleness Transition Temperature of Steels. Georges Vidal and Anatole Popoff. *Comptes rendus*, v. 240, no. 5, Jan. 31, 1955, p. 487-489.

A new tensile test method permits more rational study of temper brittleness and fatigue. Diagram. 5 ref. (Q23, Q7, SS)

452-Q. (French.) Interpretation of the Brittleness at 475° C. of Iron-Chromium Alloys. Emile Josso. *Comptes rendus*, v. 240, no. 7, Feb. 14, 1955, p. 776-778.

Proposes a new interpretation of brittleness, based on the existence of an order-disorder transformation. Graphs. 6 ref. (Q23, Fe, Cr)

453-Q. (French.) Use of Various Scientific Techniques in the Physical Study of the Plastic Deformation of Metals. Raymond Jaquesson. *Revue générale des sciences pures et appliquées*, v. 61, nos. 11-12, Nov.-Dec. 1954, p. 324-341.

Torsion testing, chemical activity, strain hardening, and rolling are considered in study of deformation by torsion. Diagrams, graphs. (Q24)

454-Q. (German.) The Problem of Brittle Fracture of Steel. W. Felix and Th. Geiger. *Schweizer Archiv für angewandte Wissenschaft und Technik*, v. 21, no. 2, Feb. 1955, p. 33-49.

Mechanisms of brittle fracture; experimental verification with a steel beam. Graphs, tables, refractograms, micrographs, photographs. 2 ref. (Q26, Q23, CN, AY)

455-Q. (German.) Nonuniform Stress Distribution in the Case of Fatigue Stresses. E. Siebel and M. Stieler. *VDI Zeitschrift*, v. 97, no. 5, Feb. 11, 1955, p. 121-126.

Evaluation of notch effect of ferrous and nonferrous metals under various loading conditions. Diagrams, tables, graphs. 14 ref. (Q7, Q25)

456-Q. (German.) Three-Dimensional Photoelasticity in High-Pressure Apparatus Design. C. Alt. *VDI Zeitschrift*, v. 97, no. 5, Feb. 11, 1955, p. 127-130.

Study of stress conditions in highly stressed pipes and vessels. Photographs, diagrams. 9 ref. (Q25)

457-Q. (German.) Application of X-Ray Microstructure Methods. Th. Geiger. *Schweizer Archiv für angewandte Wissenschaft und Technik*, v. 21, no. 2, Feb. 1955, p. 50-55.

X-ray study of the structural changes of two heat resistant steels

during creep. Tables, photographs, X-ray recordings, 6 ref. (Q3, SS)

458-Q. (German.) **The Significance of an Electron Bombardment for the Plasticity of Metal Crystals.** Erich Schmid and Karl Lintner. *Zeitschrift für Metallkunde*, v. 46, no. 2, Feb. 1955, p. 71-76.

Review of the Seitz-Brinkman theory on the effect of corpuscular radiation on solid bodies; effect of radiation on the ductility of crystals; flow tests on Zn crystals under β radiation. Graphs, 23 ref. (Q23, Zn)

459-Q. (German.) **Damping and Modulus of Elasticity of Deformed and Recrystallized Copper.** Werner Köster, Lothar Bangert and Walter Lang. *Zeitschrift für Metallkunde*, v. 46, no. 2, Feb. 1955, p. 84-89.

Temperature dependence of damping and modulus of elasticity; effects of deformation and grain size; relaxation by means of grain boundary viscosity. Graphs, 20 ref. (Q8, Q21, Cu)

460-Q. (German.) **The Properties of Molten Metals. X. Internal Friction of Liquid Magnesium-Lead Alloys.** Erich Gebhardt, Manfred Becker and Erich Trägner. *Zeitschrift für Metallkunde*, v. 46, no. 2, Feb. 1955, p. 90-94.

Dependence of internal friction upon temperature and composition; activation energy for viscous flow. Tables, graphs, 15 ref. (Q22, Mg, Pb)

461-Q. (Polish.) **Influence of Structure on the Mechanical Properties of Structural Steels.** B. Baranowski. *Prace Instytutu Ministerstwa Hutnictwa*, 1954, no. 6, p. 277-294.

Three low-alloy steels, 30 HGSA, 35 SG and 36 HNM, show different microstructures after heat treatment and tension, fatigue and impact tests. Specimens with best strength properties possessed a microstructure of tempered martensite. Graphs, tables, photographs, micrographs, 18 ref. (Q general, M27, ST)

462-Q. **Comparison of the Slow Notch-Bend Test and the V-Notch Charpy Impact Test for the Assessment of the Notch Ductility of C-Mn Steel.** *British Welding Journal*, v. 2, Mar. 1955, p. 98-106.

Tests made on 1-in. thick plates. The two methods generally gave a similar rating to the samples. Tables, graphs. (Q5, Q6, AY)

463-Q. **Creep of Zinc Crystals.** E. P. T. Tyndall, R. A. Artman, C. A. Wert and Robert Eisner. *Journal of Applied Physics*, v. 26, Mar. 1955, p. 286-294.

Studies of plastic deformation in the region just beyond the elastic limit. Diagram, tables, graphs, 7 ref. (Q3, Zn)

464-Q. **Some Effects of Variation in the Zinc Content on the Mechanical Properties and Corrosion Resistance of Al-Si-Cu Alloys.** *Metallurgia*, v. 51, no. 305, Mar. 1955, p. 115-119.

Tests to ascertain extent to which zinc content of alloys might be raised without unduly adverse effects on properties. Diagrams, tables, graphs. (Q general, R general, Al)

465-Q. **The Properties of a High-Manganese Austenitic Stainless Steel.** G. N. Flint and L. H. Toft. *Metallurgia*, v. 51, no. 305, Mar. 1955, p. 125-129.

Although in some media the corrosion resisting properties of a stainless steel containing 18% Cr, 10% Mn, 2% Ni, stabilized with titanium, are equal to those of a titanium-stabilized 18-8 Cr-Ni steel, there are many industrial applications for which the high-manganese steel would not be suitable. The ductility and deep-drawing proper-

ties of the high-manganese steel are inferior to those of the 18-8-titanium type. Tables, photographs, micrographs, 3 ref. (Q23, G4, R general, SS)

466-Q. **The Conjugate Load Method in Structural Analysis.** W. L. Schwalbe. *Royal Aeronautical Society, Journal*, v. 59, Mar. 1955, p. 199-208.

Stress analysis by applying a system of loads to a single member so that its behavior, as an isolated member, is identical to its behavior as an integral part of the structure. Graphs, tables, diagrams, 5 ref. (Q25)

467-Q. (English.) **The Formation and Growth of Kink Bands in Aluminium Crystals During Creep.** I. Igarashi and T. Ichijima. *Technology Reports, Tohoku University*, v. 19, no. 1, 1954, p. 23-32.

Creep tests of aluminum of 99.99% purity. Diagrams, graph, photographs, micrographs, 8 ref. (Q3, Al)

468-Q. (Japanese.) **Fatigue Deformation of Springs.** Katsunobu Tomita and Takeshi Hirai. *Journal of Railway Engineering Research (Japan)*, v. 12, no. 1, Jan. 10, 1955, p. 10-15.

Mechanism of fatigue; effects of rust formation on fatigue behavior. Tables, graphs, photographs. (Q7, R2, SG-b)

469-Q. (Japanese.) **Endurance of Leaf-Spring Steel as Affected by Various Heat Treatments.** Shigeo Owaku and Rikio Kurihara. *Journal of Railway Engineering Research (Japan)*, v. 12, no. 1, Jan. 10, 1955, p. 16-17.

Effect of heat treatment methods and metal hardness on service life. Graphs, diagrams. (Q7, J general, SG-b)

470-Q. (Pamphlet.) **Delayed-Yield Time Effect in Mild Steel Under Oscillatory Axial Loads.** Naval Research Laboratory. PB 111410. 39 p. 1954. Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. \$1.50.

Influence of loading rate on yield strength, especially at intermediate strain rates. Charts, diagrams, photographs. (Q27, CN)

471-Q. (Book.) **Fatigue of Metals and Structures.** H. J. Grover, S. A. Gordon and L. R. Jackson. 394 p. 1954. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. \$2.50.

Nature of fatigue failures; dependability of fatigue-test data; factors influencing fatigue behavior, and methods of detecting fatigue. (Q7)

R Corrosion

179-R. (Russian.) **Zero Charge Potential and Action Mechanism of Inhibitors of Acidic Corrosion of Iron.** E. O. Alazian. *Doklady Akademii Nauk SSSR*, v. 100, no. 3, June 21, 1955, p. 473-476.

Cathode polarization curves of iron; relation of double layer capacity to the potential on iron in sulfuric acid. Graphs, circuit diagram, 6 ref. (R5, Fe)

180-R. **Silicates as Corrosion Inhibitors in Synthetic Detergent Mixtures.** Raymond Getty, Newton W. McCready and William Stericker. *ASTM Bulletin*, 1955, no. 205, Apr., p. 50-59.

Use of sodium silicates to reduce corrosion or tarnishing of metals

by household detergent mixtures containing polyphosphates. Tables, photographs, 3 ref. (R10)

181-R. **More Heat, Less Corrosion.** *Chemical Engineering*, v. 62, Apr. 1955, p. 140, 142.

Volatile amines, in process steam, film over metal to control carbon dioxide and oxygen attack. Photograph, table. (R5)

182-R. **Metallurgical Aspects of Dry Corrosion.** L. B. Pfeil. *Chemistry & Industry*, 1955, no. 9, Feb. 26, p. 208-218.

Influence of composition, structure and stresses on corrosion at elevated temperatures. Micrographs, photographs, table, 36 ref. (R1)

183-R. **Metal Corrosion and Protection.** I. R. R. Rogers. *Chemistry in Canada*, v. 7, Mar. 1955, p. 37-38.

Corrosion mechanisms; comparison of corrosion rates of ferrous and nonferrous metals. Tables, diagram. (To be continued.) (R general)

184-R. **For Cathodic Protection Power—Refractories or Sacrificial Anodes?** Ray M. Wainwright. *Gas*, v. 31, Mar. 1955, p. 77 + 5 pages.

Application of cost concepts to help management select the system best suited to the conditions. Diagram, graph, table, 7 ref. (R10)

185-R. **Effect of the Composition of Gas-Turbine Alloys on Resistance to Scaling and to Vanadium Pentoxide Attack.** G. T. Harris, H. C. Child, and J. A. Kerr. *Iron and Steel Institute, Journal*, v. 179, Mar. 1955, p. 241-248.

Scale resistance in moving air of some typical gas-turbine alloys with and without coatings of vanadium pentoxide studied throughout their useful temperature range. Tables, graphs, diagrams, 5 ref. (R2, SG-h)

186-R. **Geometric Factors in Electrical Measurements Relating to Corrosion and Its Prevention.** W. J. Schwerdtfeger and Irving A. Denison. *Journal of Research, National Bureau of Standards*, v. 54, Feb. 1955, p. 61-71.

Discusses "electrical boundary" of a galvanic couple immersed in an aqueous medium, when corroding normally and also when corrosion is stopped by cathodic protection. Graphs, diagrams, 16 ref. (R1, R10)

187-R. **Cathodic Protection of Treating Equipment.** W. C. Koger. *Petroleum Engineer (Management Ed.)*, v. 27, Mar. 1955, p. 92B-94B.

Operating life of emulsion reduction equipment can be substantially extended through the installation of magnesium alloys. Graphs, photographs, diagram, tables. (R10, Mg)

188-R. **Stress Corrosion in High Tensile Wire.** Walter O. Everling. *Wire and Wire Products*, v. 30, Mar. 1955, p. 316-319, 346-347.

Causes and correction for corrosion of wire for prestressed concrete. Graphs, diagrams, photographs. (R1, CN)

189-R. **Influence of Temperature and Time Upon Intergranular Corrosion of Welds in 18-8 Type Steel.** N. Yu. Pal'chuck. *Henry Brucher Translation No. 3233*, 19 p. (From *Avtomaticheskaya Svarka*, v. 6, no. 2, 1953, p. 3-14.) Henry Brucher, Aladana, Calif.

Effects of carbon content, microstructure, heat treatment time and service temperature. Table, graphs, micrographs, 20 ref. (R2, SS)

190-R. **Resistance to Intergranular Corrosion of Ferritic and Martensitic Stainless Chromium Steels.** E. Houdermont and W. Tofaute. *Henry Brucher Translation No. 3443*, 19 p. (Slightly abridged from *Stahl und*

Eisen, v. 72, no. 10, 1952, p. 539-545.) Henry Bratcher, Altadena, Calif. Previously abstracted from original. See item 297-R, 1952. (R2, SS)

191-R. (French.) Study by Electron Diffraction of the Oxidation of Tin Under Reduced Pressure. Jean-Jacques Trillat, Léa Tertian, and Marie-Thérèse Plattard. *Comptes rendus*, v. 240, no. 5, Jan. 31, 1955, p. 526-528.

On heating pure tin in a vacuum, it was possible to observe the fusion phenomenon and gradual transformation into SnO and SnO₂ oxides. 2 ref. (R2, Sn)

192-R. (French.) Process of Layer Formation in the Oxidation of Copper Under Low Pressure. Finn Gronlund and Jacques Bénard. *Comptes rendus*, v. 240, no. 6, Feb. 7, 1955, p. 624-626.

Type and duration of reactions investigated as functions of oxide formed during oxidation at low pressure. 2 ref. (R2, Cu)

193-R. (German.) Activation Potentials of Iron-Chromium Alloys and Their Relationship to the Chemical Stability in Sulfuric Acid. Hans-Joachim Rocha and Gustav Lennartz. *Archiv für das Eisenhüttenwesen*, v. 26, no. 2, Feb. 1955, p. 117-123.

Dependence of activation potential upon hydrogen-ion activity in sulfuric acid on iron, iron-chromium alloys and chromium; passivity potential in sulfuric acid containing air. Graphs, table. 11 ref. (R10, Fe, Cr)

194-R. (German.) The Special Importance of Flow Rate on Sulfuric Acid Corrosion. H. W. van der Hoeven. *Werkstoffe und Korrosion*, v. 6, no. 2, Feb. 1955, p. 57-62; disc., p. 62.

Effects of velocity and accumulation of corrosion products in the corrosive agent on aluminum-nickel bronze and carbon steel. Diagrams, micrographs. (R5, Al, Ni, Cu, CN)

195-R. (German.) Alternating Current Corrosion. H. F. Schwenkhagen. *Werkstoffe und Korrosion*, v. 6, no. 2, Feb. 1955, p. 63-71; disc., p. 71.

Experimental data for d.c., a.c., and pulsating currents used to account for corrosive effects of stray currents on underground transmission lines. Photographs, tables, graphs, circuit diagram. 7 ref. (R1, R8, Cu)

196-R. (German.) Influence of Flow Rate on Scale Formation and the Subsequent Corrosion in Hot Water Supply Devices. L. W. Haase. *Werkstoffe und Korrosion*, v. 6, no. 2, Feb. 1955, p. 81-84.

Effects of water composition, container material and flow; benefits of depolarizer. Diagrams. (R4)

197-R. (German.) Soil Corrosion of Aluminum. Tihomir Markovic. *Werkstoffe und Korrosion*, v. 6, no. 2, Feb. 1955, p. 84-86.

Effects of air and water in the soil on corrosion rates. Graphs. 6 ref. (R8, Al)

198-R. (Russian.) Methods of Studying Corrosion Indicators. I. T. Deev and K. M. Morozova. *Elektricheskoe Stantsii*, v. 26, no. 2, Feb. 1955, p. 12-14.

Use of indicator discs and the metallomicroscope micrometer. Corrosion product revealed by X-ray. Table, micrographs, photograph. (R11, Cl)

199-R. Galvanic Corrosion Behavior of Titanium and Zirconium in Sulfuric Acid Solutions. David Schlain, Charles B. Kenahan and Doris V. Steele. *Electrochemical Society, Journal*, v. 102, Mar. 1955, p. 102-109.

Studies of couples with aluminum alloys or 18-8 stainless steel. Diagram, tables, graphs. 8 ref. (R1, Ti, Zr, Al, SS)

S

Inspection and Control

59-S. Metals Engineering and Radioactive Materials. G. G. M. Carr-Harris. *Canadian National Research Council, Technical Information Service Report No. 42*, Dec. 1954, 37 p.

Uses of radioisotopes in nondestructive testing, study of dynamic processes and in various instruments. 175 ref. (S19)

60-S. Assessment of Quality of Wrought Products. W. G. Shilling. *Institute of Metals, Journal*, v. 83, Feb. 1955, p. 193-198.

Inspection procedures; sampling; nondestructive testing. (S general)

61-S. The Control of Quality in Heat-Treatment and Final Operations in the Production of Rolled, Extruded, and Drawn Aluminium and Aluminium Alloys. A. J. Field and J. Salter. *Institute of Metals, Journal*, v. 83, Feb. 1955, p. 199-220.

Factors that should be controlled to insure satisfactory quality in the finished product. Operations covered include sheet shearing from coil, flattening, finish shearing, slitting, blanking, straightening of sections, drawing and finishing of tubes, inspection and packing. Tables, diagram. 10 ref. (S general, F general, J general, Al)

62-S. The Control of Quality in the Heat-Treatment and Finishing of Copper and Copper-Base Alloys. V. B. Hysel and T. W. Collier. *Institute of Metals, Journal*, v. 83, Feb. 1955, p. 233-246 + 1 plate.

Inspection and controls for heat treating, shearing, straightening, cutting to length and removal of burrs. Tables, micrographs, photographs. 6 ref. (S general, J general, F general, Cu)

63-S. Mechanical Failures of Metals in Service. John A. Bennett and G. Willard Quick. *U. S. National Bureau of Standards Circular 550*, Sept. 1954, 36 p.

Thirty-five representative types of failure. Factors of design, fabrication or use contributing to these failures. Photographs, tables, graph, micrographs. 6 ref. (S21, Q general)

64-S. Ultrasonic Methods for Studying the Properties of Hardened Steel and for Detecting Internal Defects in Steel Parts. S. Ya. Sokolov. *Henry Bratcher Translation No. 3392*, 19 p. (From *Zhurnal Tekhnicheskoi Fiziki*, v. 11, nos. 1-2, 1941, p. 160-169.) Henry Bratcher, Altadena, Calif.

Fundamentals of ultrasonic testing; measurement of case depth and detection of inclusions. Diagrams, micrographs, photographs. (S13, ST)

65-S. (Dutch.) Detection of Hair-Line Cracks in Metals. *Bedrijf en Techniek*, v. 10, no. 220, Jan. 29, 1955, p. 57-58, 65.

The magnaflex, "Met-L-Chek," and ultraviolet-light methods for detecting cracks in ferrous and non-ferrous metals. (S13)

66-S. (French.) Gamma Radiography: A Nondestructive Testing Technique for Industrial Applications. F. C. Fontenay. *Métalurgie, Corrosion-Industries*, v. 30, no. 353, Jan. 1955, p. 9-17.

Characteristics of radiations from various radioisotopes; equipment and techniques. Photographs, table, gammagraph. (S19)

67-S. (German.) The Importance of Radioactive Radiation to Materials Science. P. Müller. *VDI Zeitschrift*, v. 97, no. 5, Feb. 11, 1955, p. 138-144.

Effect of various types of radiation on properties of metals, plastics, ionic crystals, glasses and liquids; use of radioactive rays and radioactive tracers in testing materials. Photographs, graphs, table. 18 ref. (S19, P10)

68-S. Methods of Bond Testing. W. J. McGonnagle, J. H. Monaweck and W. G. Marburger. *Nondestructive Testing*, v. 13, Mar.-Apr. 1955, p. 17-22.

The ultrasonic transmission method was most sensitive, the electrode potential and thermographic methods less sensitive. Diagrams, graphs, tables, photographs, micrographs. 3 ref. (S general, L24)

69-S. Industrial X-Ray Fluoroscopic Apparatus Design. Charles A. Mitchell and Warren W. Inglis, Jr. *Nondestructive Testing*, v. 13, Mar.-Apr. 1955, p. 23-27.

Two types of industrial fluoroscopes in which effort has been made to incorporate recent innovations for examination of critical ordnance components. Diagrams, photographs, tables. (S13)

70-S. Safe and Economical Use of Isotopes in the Steel Industry. C. A. Karrer. *Nondestructive Testing*, v. 13, Mar.-Apr. 1955, p. 29-31.

Operation and physical layout of gamma-ray testing equipment. Photographs. (S13, S19)

71-S. (Japanese.) Statistical Investigation of Broken Springs. Katsunobu Tomita, Susumu Kikuchi and Takeshi Hirai. *Journal of Railway Engineering Research (Japan)*, v. 12, no. 1, Jan. 10, 1955, p. 6-9.

Analysis of causes of service failures of leaf springs on Japanese freight cars. Graphs, tables. (S21, SG-b)

72-S. (Pamphlet.) Symposium on Radioactivity—an Introduction. ASTM Special Technical Publication No. 159. 46 p. 1954. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Six papers on measurement uses and handling techniques for radioisotopes. (S19)

T

Applications of Metals in Equipment

48-T. Role of Liquid Metals in Nuclear Power Development. J. W. Taylor. *Research*, v. 8, Mar. 1955, p. 102-105.

Potential applications as coolants and heat transfer media, carriers for nuclear fuel, and extraction agents in processing spent fuel. Table. (T25, Na, Li, Pb, Bi)

49-T. Revolution in Rectifiers. Van Caldwell. *Steel*, v. 136, Mar. 21, 1955, p. 116-119.

Manufacture, properties and applications of germanium, selenium and silicon rectifiers. Photographs, diagrams. (T1, Ge, Se, Si)

V

Materials

General Coverage of Specific Materials

98-V. Titanium Reference Sheet. I. G. E. Hutchinson. *Chemical Engineering Progress*, v. 51, Mar. 1955, p. 34.

Data on Rem-Cru products. (T1)

99-V. **The Heat-Treatment, Inspection, and Testing of Wrought Nickel and Nickel Alloys.** W. Betteridge and T. E. Cound. *Institute of Metals, Journal*, v. 83, Feb. 1955, p. 262-270 + 2 plates.

Processing procedures; inspection methods; process testing. Tables, micrographs, photographs. 14 ref. (J general, S general, NI)

100-V. **Austenitic Manganese Steel. Properties and Uses.** T. H. Arnold. *Iron & Steel*, v. 28, Mar. 1955, p. 95-97.

Mechanical properties, heat treatment, structure and applications. Micrographs. (AY)

101-V. **Chromium-Base Alloys.** R. G. Nelson and H. G. Anderson. *U. S. Bureau of Mines, Report of Investigations*, 5107, Jan. 1955, 20 p.

Development of chromium-rich alloys for high-temperature uses with high-purity chromium produced by a hydrogen-treatment method. Tables, graph, photographs, micrographs. (Cr)

102-V. (French.) **Studies of Ni-Cu, Cr-Cu, and Ni-Cr-Cu Steels With Structural Hardening.** H. Laplanche. *Métallurgie et la construction mécanique*, v. 87, no. 2, Feb. 1955, p. 107-109, 111, 113-115, 117.

Structures, transformations, corrosion resistance and mechanical properties of copper-bearing steels. Diagrams, graphs, tables. 22 ref. (AY)

103-V. (French.) **High Strength "ALS" Steels for Light Construction.** Aldo Bartocci. *Métaux, Corrosion-Industries*, v. 30, no. 353, Jan. 1955, p. 18-33.

Properties and applications of new Italian low-alloy steels. Tables, micrographs, graphs, photographs. (AY)

104-V. (French and German.) **Scientific Knowledge of Metals.** Th. Zürcher. *Pro-Metal*, v. 7, no. 43, Feb. 1955, p. 456-467.

Compositions and properties of various bronzes and German silver. Graphs, diagrams, tables, photographs. 3 ref. (Cu, Ni, Zn)

105-V. (Russian.) **Titanium: Properties, Uses, and Methods of Producing It.** I. I. Kornilov. *Uspekhi Khimii*, v. 23, no. 5, 1954, p. 529-546.

Survey of work, including author's own recent contributions. Tables, graphs, diagrams. 37 ref. (Ti)

106-V. **Aluminum 4032. Heat Treatable Aluminum Forging Alloy.** *Alloy Digest*, no. Al-25, Apr. 1955.

Composition, physical constants, properties, heat treatment, machinability, weldability and applications. (F22, Al)

107-V. **Eastern Z-Metal. Pearlitic Malleable Iron.** *Alloy Digest*, no. Cl-10, Apr. 1955.

Composition, physical constants, properties, castability, machinability, heat treatment, weldability and applications. (CI)

108-V. **Muntz Metal. High Strength Brass.** *Alloy Digest*, no. Cu-25, Apr. 1955.

Composition, physical constants, properties, machinability, weldability, heat treatment, workability, corrosion resistance and applications. (Cu)

109-V. **Durichlor. High Silicon Iron.** *Alloy Digest*, no. Fe-7, Apr. 1955.

Composition, physical constants, machinability, corrosion resistance, weldability and applications. (Fe)

110-V. **"KR" Monel. Corrosion-Resistant Nickel-Base Alloy.** *Alloy Digest*, no. Ni-13, Apr. 1955.

Physical constants, composition, properties, heat treatment, machinability, grinding, weldability, corrosion resistance, pickling and applications. (Ni)

111-V. **AISI 3140. Nickel-Chromium Alloy Steel.** *Alloy Digest*, no. SA-29, Apr. 1955.

Composition, physical constants, properties, heat treatment, weldability, machinability and applications. (AY)

112-V. **Rem-Cru C-110M. Titanium-Base Alloy.** *Alloy Digest*, no. Ti-6, Apr. 1955.

Composition, physical constants, properties, heat treatment, machinability, workability, weldability, corrosion resistance, cleaning and applications. (Ti)

113-V. **Solar. Water-Tough Tool Steel.** *Alloy Digest*, no. TS-32, Apr. 1955.

Composition, properties, heat treatment, machinability, workability, weldability and applications. (TS)

114-V. **Titanium in Cast Iron.** George F. Comstock. *Foundry*, v. 83, Apr. 1955, p. 118-123.

Effect of titanium on microstructure, mechanical properties, machinability and corrosion resistance. Photographs, micrographs, tables. 29 ref. (Ti, CI)

115-V. **Titanium Fills Need for Super Material in Aircraft of the Future.** N. E. Promisel. *Journal of Metals*, v. 7, Mar. 1955, p. 443-448.

Review of properties, applications, production statistics and future possibilities. Photographs, graphs, table. 2 ref. (T24, Ti)

116-V. **Rhenium Metal.** Chester T. Sims. *Materials & Methods*, v. 41, Mar. 1955, p. 109-111.

With development of suitable fabricating techniques, the interesting physical, mechanical, chemical and electronic properties of this new metal are now being exploited. Production methods, properties, fabrication procedures and applications. Photographs, graph, table. 6 ref. (Re)

117-V. **Materials Engineering File Facts. Cast Stainless Steels.** *Materials & Methods*, v. 41, Mar. 1955, p. 139, 141, 143.

Mechanical, physical, corrosion and fabricating properties; applications. (SS)

118-V. (Book.) **Package of Reports on Titanium and Its Alloys.** Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. \$40.00.

Collection of 42 reports covering all phases of the production, working, applications, and properties of titanium and titanium alloys. (Ti)

119-V. (Book.) **Titanium in Industry.** Stanley Abkowitz, John J. Burke and Ralph H. Hiltz, Jr. 224 p. 1955. D. Van Nostrand Co., 250 Fourth Ave., New York, N. Y. \$5.00.

The production, properties, and processing of titanium and its alloys; various extracting procedures; heat treatment methods; working, analytical, and metallographic techniques. (Ti)

120-V. (Book.) **Watkins Cyclopedia of the Steel Industry.** 5th Ed. 485 p. 1955. Steel Publications, Inc., 4 Smithfield St., Pittsburgh 30, Pa. \$10.00.

Reference book on the activities of the steel producing and processing industries. (ST)

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VACUUM MELTING ENGINEER: Large Cleveland aircraft manufacturer requires at once services of metallurgical engineer to supervise development program on vacuum melting of aircraft alloys. Previous experience with high-temperature alloys essential. Send complete resume of experience, background and salary expected. Replies confidential. Box 5-130.

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WELDING ENGINEER: To head welding research section of leading manufacturer of alloy, stainless, toolsteels and high-temperature alloys. Solid background of experience with various welding methods and techniques as applied to alloys difficult to weld is essential. Location: Pittsburgh. In reply submit full resume, personal description and indicate salary requirement. Box 5-50.

PROCESS METALLURGIST: Responsible for quality control for heat treating ferrous and nonferrous metals. Must be able to prescribe remedies as conditions warrant and improve on factory operations. Basic metallurgical background essential. State education, experience and salary expected. Box 5-55.

METALLURGIST: Recent graduate for brass and copper alloy mill metallurgical department. Opportunity to gain broad knowledge of entire rod, strip, tube and wire mill operations while working as process research metallurgist and leading to customer technical service, process development and mill management positions. Location: Waterbury, Conn. Box 5-60.

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METALLURGIST: Needed as process met-

allurgist in brass mill manufacturing beryllium-copper, phosphor-bronze and nickel-silver in form of strip, wire and rod. Excellent position offering advancement and many benefits. Reply fully giving age, experience and salary desired to: Personnel Dept., Riverside Metal Co., Division of H. K. Porter Co., Inc., Riverside, N. J.

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TOOLSTEEL SALESMAN: Prominent independent distributor wants experienced toolsteel salesman, preferably with established following in New York-New Jersey area. Reply in confidence, advising experience, qualifications and salary expected. Box 5-75.

FURNACE ENGINEER: Man experienced in industrial furnace design. Salary \$3500. State experience in writing. Box 5-80.

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RESEARCH METALLURGIST: M.S. degree in physical chemistry, research and development experience in physical metallurgy for A.E.C. and large steel corporation. Metallography, X-ray diffraction, precipitation hardening, arc melting, vacuum melting, phase diagram, mechanical testing, heat treatment and technical report writing. Desires responsible position, preferably in product development in Northeast. Box 5-90.

METALLURGIST: M.S. degree, age 33, married, family. Background includes experience in teaching, heat treating (including operation of own company), ferrous research and product development with emphasis on toolsteels. Current position as senior research metallurgist entails research activities with minimum supervision and preparation of clear concise reports. Interested primarily in Delaware Valley area. Box 5-95.

METALLURGICAL LIBRARIAN/LITERATURE SPECIALIST: Nine years in rare metals, nine years in ferrous metals, with responsibility for keeping research groups up-to-date on English and foreign literature. Has organized and managed libraries in both specialties, including patent and research records. Box 5-100.

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 4300 East 5th Avenue
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Uranium Division
Mallinckrodt Chemical Works
65 Destrehan Street
St. Louis 7, Mo.

ried, age 31, veteran. Box 5-105.

METALLURGIST: B.S. degree, age 26, single, veteran. One year as metallurgical observer in steel plant, 1½ year in metallurgical laboratory dealing with high speed steel investigations. Desires research and development or production in east. Box 5-110.

EXECUTIVE'S TECHNICAL ASSISTANT, RESEARCH DIRECTOR, CHIEF METALLURGIST: B.S. degree, 15 yr. in foundry, production, administration in stainless, carbon steel, gray iron, nickel, nonferrous alloys. Successful in research and development resulting in improved casting quality, scrap reduction and lower costs. Cool, conscious and alert to potentials in applied research. Age 37, married. Box 5-115.

METALLURGIST: M.S. degree, graduate courses, single, age 30. Five years in research development of tungsten and molybdenum, including metalworking, steel and nonferrous. Background in nuclear, mechanical, theoretical physical metallurgy, solid state physics. Seeks future and advancement. Location not important. Box 5-120.

METALLURGIST: B.S. degree, age 34, married, children, 8 yr. experience in ferrous and nonferrous metallurgy, including laboratory supervision, failure analysis, customer and vendor contacts, quality control, report and specification writing, heat treating, metallography and selection of materials for new designs. Box 5-125.

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Ohio aircraft and industrial manufacturer has need for Metallurgical Development Group Supervisor. Experience in the fields of high-temperature alloys, steels, aluminum alloys and titanium are essential. Background should also include familiarity with various laboratory testing facilities. Ability to organize development programs, supervise activities of other metallurgists, and prepare reports essential.

Box 5-5, Metals Review

METALLURGISTS

Alloy Development—Composition development for high-temperature and magnetic alloys, phase diagrams, creep, precipitation hardening, vacuum melting and other techniques. Development experience in powder metallurgy, physical metallurgy or alloy systems, background in theoretical physical metallurgy and knowledge of solid state physics useful; M.S. or Ph.D. degree in metallurgical engineering desirable but not required.

Metals Application—Guidance of design and manufacturing engineers in the selection and processing of ferrous and nonferrous metals.

Metallography—Experienced metallurgist to evaluate structures of ferrous and nonferrous commercial and experimental alloys.

Pilot Plant—Follow process development of casting, working and heat treatment of specialized high-temperature and magnetic alloys.

Send complete resume including salary expectations to:

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METALS RESEARCH CERAMIST Plan and conduct research in fields of intermetallics, metalloids, ceramic and metal ceramic materials. Ph.D. or Sc.D. in Metals Ceramics with strong background in Physical Chemistry.

RESEARCH AND SALES DEVELOPMENT METALLURGISTS (2) Scientists to plan and execute experimentation on: (a) titanium and titanium-base alloys; and (b) non-ferrous high-temperature alloys. Design experiments for studying transformations and for generalizing mechanical and physical behavior in terms of structure. Ph.D. or M.S. up to three years research experience, with training in solid-state transformations and theoretical physical metallurgy.

SENIOR RESEARCH CHEMIST Inaugurate comprehensive research programs to investigate inorganic compounds. Apply strong theoretical and application background in both the preparation and purification of elements and compounds. Ph.D. in chemistry with a minor in physics.

METALLURGICAL RESEARCH ENGINEERS (2) Conduct research with emphasis on: (a) steels and ferrous alloys; and (b) high-temperature thermochemistry and process metallurgy. The steel and ferrous investigations will include fabrication and heat-treatment as well as metallographic studies; and will require a B.S. or M.S. in Metallurgy or Metallurgical Engineering with 1-3 years experience. The high-temperature thermochemistry research will extend into problems of physical chemistry of steel making, extractive metallurgy and process metallurgy. A Ph.D. in Metallurgical Engineering or M.S. with related experience is required.

RESEARCH ENGINEER Conduct research on mineral and metal extraction problems. Improve methods of mineral recovery, develop process and flow sheet, perform research on comminution, flotation, electrostatic and magnetic separation. Ph.D. or Sc.D. in Mineral Engineering or Metallurgical Engineering.

CHEMICAL ENGINEER—SUPERVISING DESIGN ENGINEERS Capable men to design or supervise design of major structures, buildings, services, and utilities for varying sized projects. Select machinery and equipment; prepare cost estimates, specifications, requisitions; make bid comparisons for equipment purchases and construction costs. When necessary, supervise erection of buildings and installation of machinery, etc. at job site. Five to ten years' experience essential.

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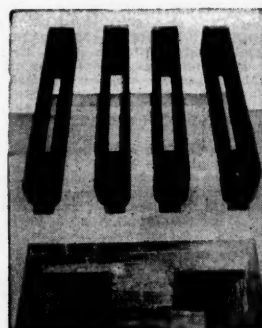
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